THE RECLAMATION ERA

JANUARY 1938

KITTITAS MAIN CANAL, YAKIMA PROJECT, WASHINGTON

THE BUDGET
(FISCAL YEAR 1939)

THE PRESIDENT'S BUDGET for the fiscal year 1939 recommends appropriations of $36,390,000 for the continuation of construction of reclamation projects. It also recommends continuing available during 1939 the unexpended balances of the previous year's appropriations and of Public Works and Emergency Relief Appropriation allotments. For the fiscal year 1938, $40,375,000 was appropriated for construction work on reclamation projects.

The appropriation of $36,390,000 plus the unexpended balances, as recommended by the President, would permit the Bureau to progress during 1939 with its planned construction program, initiated in 1933 with emergency fund allotments, without interruption or serious curtailment.

The amount recommended includes $7,410,000 for appropriation from the Reclamation Fund, a special revolving fund created by the original Reclamation Act of June 17, 1902. The appropriation of the amount recommended will provide for continuing construction of the Gila and Salt River projects in Arizona, the Boise-Payette, Minidoka, and Upper Snake River storage projects in Idaho, the Sun River project in Montana, the Carlsbad and Rio Grande projects in New Mexico, the Deschutes and Owyhee projects in Oregon, the Yakima-Roza project in Washington, and the Kendrick, Riverton, and Shoshone projects in Wyoming.

Expenditures from the Reclamation Fund are dependent upon the income to the fund from the sales of public lands, oil royalties, etc., and repayments by the water users. If the income to the fund meets expectations, there should be no interruption or curtailment of construction work on these projects.

Appropriations of $24,980,000 from the general fund of the Treasury are recommended for the larger multiple-purpose projects now under construction. This amount includes $3,500,000 for the Boulder Canyon Dam and power plant, $500,000 for continuation of construction of the All-American Canal in California, $9,000,000 for the Central Valley project in California, $2,030,000 for the Colorado River flood control project in Texas, and $13,000,000 for the Grand Coulee Dam project in Washington.

The appropriations recommended for these projects are adequate for an economical construction program with the exception of the Grand Coulee Dam project in Washington, where the current construction program requires the expenditure of approximately $2,000,000 monthly. The construction program for that project may have to be curtailed materially.

Appropriations are also recommended for investigation work and the regular operation and maintenance program.

The Budget message of the President commented on reclamation projects as follows:

"Reclamation projects have been started which will call for future appropriations of nearly $600,000,000. It seems obvious to me, and I hope it will be to the Congress, that no further projects should be authorized until projects now under construction have reached a substantial stage of completion."

JOHN C. PAGE, *Commissioner.*

PRICE ONE DOLLAR A YEAR

THE RECLAMATION ERA

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Grand Coulee Dam, a National Development

By HON. HAROLD L. ICKES, *Secretary of the Interior*[1]

TODAY we are taking the second step in the building of the greatest dam in the world. The base of Grand Coulee Dam, already the most massive masonry structure built by man, is nearly finished in the bottom of the Columbia River canyon west of Spokane. Now bids are being opened for the completion of this tremendous structure to its full height of 553 feet. The work already done and that covered by the new contract will involve the placement of three times as much masonry as went into the Great Pyramid of Cheops. Here is a job worthy of the best that science and engineering, that labor and industry have to offer. Grand Coulee Dam will endure for many thousands of years; testifying to the imagination, the ingenuity, and the skill of this generation.

However, if I may be permitted to venture a prophecy, it is that in the distant years to come this project will have given us a more coveted title than simply that of "builders of great dams." In saying this I do not mean to detract from the honor due to the engineers and the workmen who are building Grand Coulee Dam. Even they, I think, will agree that the significance of the dam is not found alone in the magnitude of its dimensions nor in the workmanship that has gone into its construction. It lies rather in the ends which are to be served.

Grand Coulee Dam will minister to many useful purposes. It is destined to have a profound influence on the social and economic life of the Pacific Northwest, which will be reflected throughout the country. It will serve to reduce flood peaks; to improve navigation; to store and to permit the diversion of sufficient water to irrigate a rich desert area one and one-half times as large as the State of Rhode Island; and to generate half again as much power as Boulder Dam. It will serve also, through regulation of the flow of the Columbia River, to improve markedly the power output of all downstream plants, including that at Bonneville Dam.

All of this will mean new homes and new opportunities for half a million or more Americans and new wealth for the Nation.

This is one of the most important conservation projects ever undertaken. It is not an experiment because it is cut on the same pattern as other projects that are now in successful operation which were built a generation ago by the Bureau of Reclamation of the Department of the Interior.

A Prophecy

In coming years, when this work shall have been completed and this desert shall have been made fruitful, men and women still will travel half around the world to gaze upon the dam itself, and they will see much more than a tremendous, symmetrical pile of concrete in the great gorge of the Columbia River. They will see the homes and the villages and the cities; the farms and the factories; and the civilization that this dam will have created.

Grand Coulee Dam is not a State or a regional undertaking; it is a national development. The wealth it will produce will be part of our national assets. Even today, in constructing the dam, it is necessary to reach out to distant places for materials. Half of the money spent on it goes into the States east of the Mississippi River for materials ranging from tacks to turbines, thus providing employment for many men and women. Each of the 48 States will contribute something vital to the building of Grand Coulee Dam. When this project is finished, families from every part of the Nation will participate in the new opportunities that it will offer.

When our grandchildren visit Grand Coulee Dam, they will understand all of these things, of which this great structure will be a pregnant symbol. And they and their children will think of this as an age of farseeing planners and expert builders. They will be grateful for the foresight and the energy of a great President which have made fruitful and productive a great barren area.

[1] Address delivered Dec. 10, 1937, at Washington, D. C., over the Mutual Broadcasting System in connection with the opening of bids by Bureau of Reclamation officials for the completion of Grand Coulee Dam.

Opening of Bids for Contract to Complete Grand Coulee High Dam

ON THE Columbia River in eastern Washington the second stage of construction of Grand Coulee Dam, the biggest single building job on earth, is about to get under way.

Bids were opened December 10 at Spokane, Wash., by the Bureau of Reclamation for completion of the mammoth Columbia River barrier to its full height of 553 feet.

The base of the dam, which was begun in 1934, will be completed in January 1938, about 18 months ahead of schedule. The base already makes the greatest masonry structure so far built by man, and it is little more than half as large as the remainder of the dam which will be covered by the new contract.

Bidders were required to post bonds totaling $7,500,000 to assure completion of the contract and payment of bills for labor and material. A performance bond of $5,000,000 and a payment bond of $2,500,000 were required of the successful contractor.

Two bids were received as follows:

First, Interior Construction Co. of Oakland	$34, 442, 240. 00
Second, Pacific Constructors, Inc., of Los Angeles	42, 185, 802. 50

The first company is comprised of the Mason-Walsh-Atkinson-Kier Co., the Morrison-Knudsen Co., the J. F. Shea Co., McDonald & Kahn, Pacific Bridge Co., Henry J. Kaiser Co., Utah Construction Co., and the General Construction Co. Henry J. Kaiser is president of the low bidders' company and T. J. Walsh is president of the board.

The second company is composed of the Griffith Co.; Lawler & Maguire; Shofner, Gordon & Hinman; Metropolitan Construction Co. of Los Angeles; D. W. Thurston of Pasadena; American Concrete & Steel Pipe Co.; Hunkin & Conkey; and the L. E. Dixon Co. of Los Angeles.

Also One-third Is ILL-WATERED

By JOHN C. PAGE, *Commissioner of Reclamation* [1]

WEST of the 100th meridian in the United States there are 700,000,000 acres of arid or semiarid lands. Seventeen of the big Western States are included in whole or in part in this region, where generally agriculture cannot progress safely beyond the rudimentary pastoral stage without irrigation.

It is difficult to imagine 700,000,000 acres of land and the 100th meridian cannot be seen, although in some respects it is as important a feature of the country as the Continental Divide.

President Roosevelt has said that one-third of the Nation is ill-nourished, ill-clad, and ill-housed. Let us add: also one-third is ill-watered. Seven hundred million acres—an astronomical-sounding figure—represent one-third of all the land in the United States. Normally crops are harvested each year from less than half that much land in the entire country. It takes all of Washington, Oregon, California, Idaho, Utah, Nevada, Arizona, Montana, Wyoming, Colorado, and New Mexico (all big States) and a good share of North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, and Texas, to make up 700,000,000 acres.

To find the 100th meridian, turn to the map of the United States in any handy atlas. You will see that it splits off the western third of the country, running down just east of Pierre, S. Dak.

East of the 100th meridian, the lands normally receive sufficient rainfall for crops. West of it they do not. Except for high mountains and a narrow strip along the Pacific coast north of San Francisco, nowhere west of the 100th meridian can more than 20 inches of rain be expected in a year. Twenty inches is not sufficient for most tilled crops. Over vast areas of the West much less than 15 inches is the normal, and in some places only 3 inches are received annually. Three inches will not support life.

The United States came into possession of this vast domain in blocks, beginning with the Louisiana Purchase. The difference between the arid and semi-arid lands and those of the humid regions, previously settled by the American people, was not reflected in national policy for many decades. It was recognized early that irrigation must play an important role in the agriculture of the West, but the homestead laws which had served well in the humid regions remained in effect. The Government for several generations followed its historic policy of encouraging and sponsoring settlement of its newly acquired territory, despite the aridity of the land, by making it easy for an individual to obtain a rectangular piece of it. What the homesteader could do with the dry land thus obtained, was left to him.

It was not until 1902, when the Federal Reclamation Act was adopted, that the United States began to modify its policy to fit the conditions encountered in the West. The Taylor Grazing Act, 3 years ago, marked the final reversal of the old system by setting aside much of the remaining unappropriated public domain permanently for pastures.

It takes us a long time to learn. I find still that some who know nothing of the West apparently believe that irrigation is unnecessary out here. The prehistoric Indians and the early Spanish missionaries, who were not encumbered with pre-conceived notions, founded their settlements on irrigated lands centuries before the first American came. They did not try to dry-farm areas which received insufficient rainfall for tilled crops, as we did. We did it, simply because somewhere to the east, perhaps 1,000 miles distant, crops could be grown without dams and canals to bring water to the land. The Indian knew little or nothing of the humid region to the east. The Spaniard came by way of Mexican deserts from the Mediterranean where irrigation is as old as civilization. The American, however, came overland through the tall prairie grasses from the lush fields of the East.

Irrigation Necessary

Out here in the West, it was realized early that irrigation would be necessary. The young Western States quickly passed laws authorizing and assisting the formation of irrigation districts and other agencies through which their agriculture could be developed. More than 50 years ago, agitation arose for Federal sponsorship of irrigation. The Nation has had a definite and firm policy with respect to irrigation for 35 years. It is embodied in the Federal reclamation laws. Without attempting to elaborate here, I will briefly sketch this policy. It is and has been from the outset one of helping the West to help itself. Public funds gathered principally from western sources, such as the sale of public lands and the leasing of oil lands, have gone into a special revolving fund for use in constructing irrigation works. Settlers on the projects are required to repay to the reclamation fund without interest the cost of the structures and canals which serve them. The purpose of Federal reclamation is to strengthen the West and to provide opportunities for people to make homes for themselves and to earn decent livings from the land.

Not only do some people who are not acquainted with the West find it difficult to understand why irrigation is necessary, but many others have a misconception of its extent. Few realize that in all of the arid and semiarid region there are less than 20,000,000 acres of irrigated lands, and that this very small percentage of the total 700,000,000 acres provides the principal support for 12,000,000 or more people. Even fewer realize that the grand total of western lands which are now irrigated and which can be irrigated by the available water supply will be only about 30,000,000 acres. I have had men, frankly disturbed at our efforts to expand irrigation, ask me in all earnestness if the Federal Government would irrigate all of Nevada. Now, Nevada is a very large State. The agriculture of Nevada, like that of the remainder of the West, is limited by water, not by land. In Nevada it is so severely limited that the control and use of every drop of water in the State would permit the irrigation of an area no larger than one or two Iowa counties. If there were enough water in Nevada to irrigate all its lands, irrigation there probably would be required no more than it is in Iowa. Iowa is small in area when compared with any one of the States of the West. Yet if all the water of all these Western States were used in irrigation, it would irrigate an area no larger than Iowa.

Irrigation must stop when all the waters available in the West for use by feasible projects are utilized. It cannot be permitted to stop short of that time. This limit may be reached all too soon.

The Department of Agriculture tells us that soil erosion has impoverished or ruined 200,000,000 acres of once productive farm lands. That is 10 times the amount of land now irrigated in the West! It tells us further that an additional 100,000,000 acres of useful farm land is actively affected by erosion and that its productivity is threatened. That is 10 times the amount of land which may in the future be irrigated in the West! The Nation is engaged in an earnest attempt to remove from cultivation a part of its submarginal lands; thus to free from a peonage wrought by nature and misuse of the soil a section of our population. Recently a 7-years' drought, as yet unbroken, has driven 100,000 farm families from the Great Plains. Where are these people to go?

Many of them go West looking for new opportunities; hoping to find homes on irrigated lands. If these people are to resume

[1] Address delivered at Spokane, Wash., in connection with the opening of bids for completion of Grand Coulee Dam, Dec. 10, 1937.

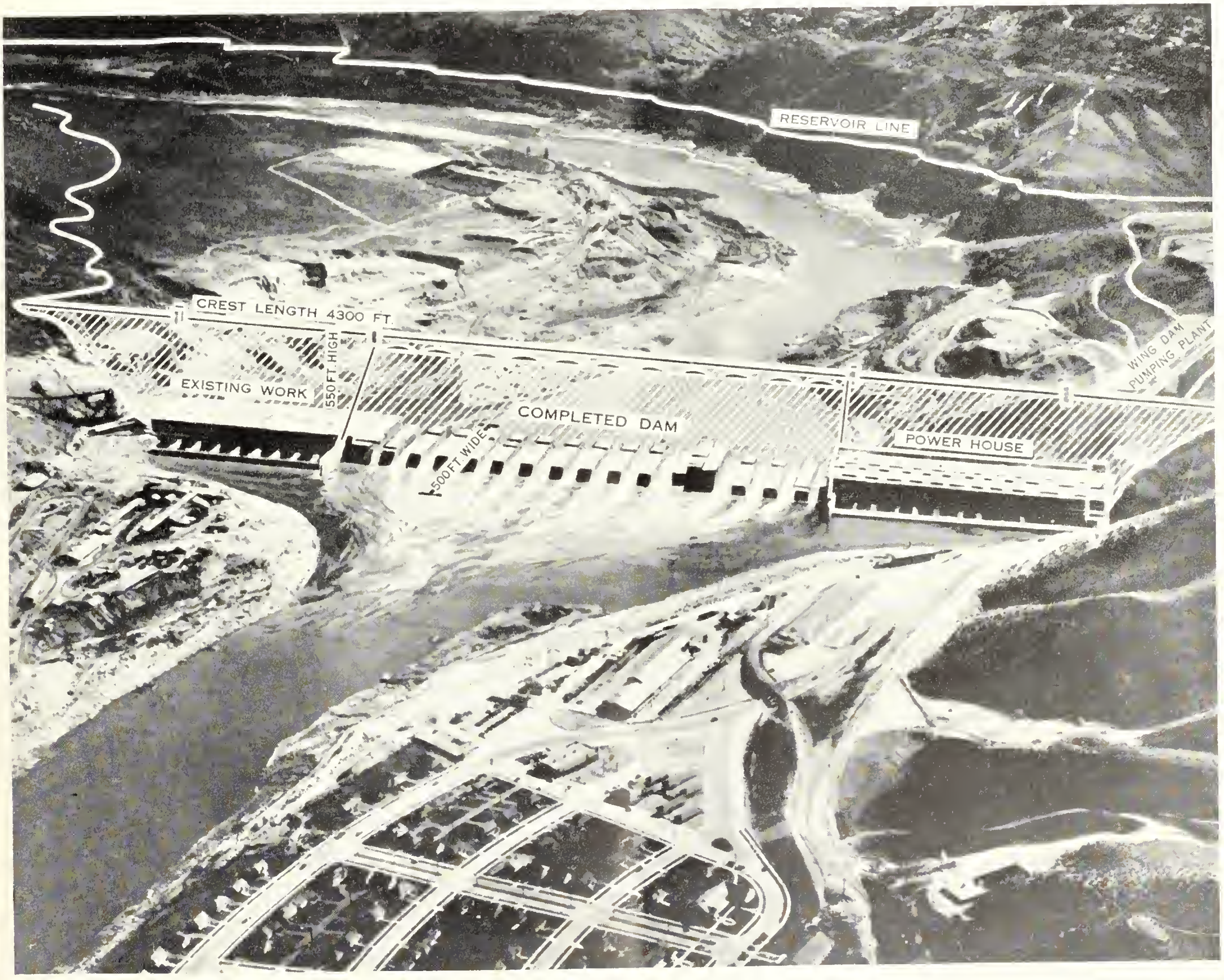
their life work, many of them must find irrigated farms.

This brings us to one of the major functions of Federal Reclamation in our national land-use program. Only about 3,000,000 acres now are irrigated by Federal projects. This land, however, supports directly approximately 900,000 people living on farms and in towns on the projects. The present construction program, though it may be considered large, will irrigate but an additional 2,500,000 acres when the projects are completed. This total includes the 1,200,000 acres of the Grand Coulee Dam-Columbia Basin project, a long-range development which will not be finished within, perhaps, 30 years. Our construction program cannot make new lands available fast enough to take care of the demand arising among those who have been driven from their homes in other areas. In October, 65 new farms were opened for settlement on the Klamath project. More than 1,500 war veterans, who are given preference under the law, applied for them the first day. Many of these men were from the Great Plains. The Columbia Basin project, if it were finished at this time, would provide homes for less than half of the farm families already driven by drought from the Great Plains alone. I would that we were prepared now to start the pumps at Grand Coulee Dam and to turn the water into the canals which eventually will form a net over the fine land to the south of the dam. We would then be in a position to help at least a fraction of those who are in need.

Irrigated Crops not Competitive With Those of Humid Areas

Farmers in other areas need have no fear of irrigation. Irrigated agriculture has complementary relationships rather than competitive relationships with the agriculture of humid areas. The staple crops, of which there are exportable surpluses in other regions, are produced only in inconsequential amounts on the irrigated lands of the West. Two types of crops dominate on irrigated lands, and neither is competitive with those of other regions. First, from the standpoint of acreage, are the forage and fodder crops which provide half the feed for the livestock industry of the West; the most important industry of this region. First from the standpoint of

The base of Grand Coulee Dam as it will look upon its completion early in January, with the remainder of the dam that section covered by the new contract—sketched in.



returns to the farmer are the specialty crops, sugar beets, vegetables, melons, and fruits. At the risk of seeming paradoxical, I will assert that these crops are not competitive generally with those of any other area in the United States.

The livestock industry of the West makes use of the vast pastures provided by nature here. Great expanses of these ranges could not be used except for the comparatively small irrigated patches scattered through them. These irrigated dots on the map of the West produce hay for winter feeding, without which the cattle and sheep could not be kept here at all. These western ranges and irrigated fields produce the larger part of all the feeder stock finished-out in the feed lots of other areas. In the feed lots of the Midwest, the farmer in that region who produces corn finds a major outlet for his crop. Obviously, this segment of the agriculture of the irrigated lands of the West complements the agriculture of the humid States. Obviously, there is no competition here.

The specialty crops, and nearly every irrigated area in the West has a different one, also complement the production of other areas. The sugar beets of irrigated fields in the Rocky Mountain region glut no market upon which the mid-western, eastern or southern farmer relies. The lettuce and cantaloupes, the tomatoes and pears of the irrigated fields in California, Arizona, Utah, or Colorado have served only to balance the winter diet of the great cities from New York and Boston westward. Introduction of these crops in the irrigated sections, which have long growing seasons, has been of distinct service in the improvement of the health of the Nation. Only those who could afford to pay for hothouse vegetables 30 years ago could eat salads the year around. Now it is difficult to find a market from Maine to California that does not carry fresh vegetables, priced reasonably enough for all, throughout the year. The irrigated West is responsible.

No one ships lettuce, or any other vegetable, from California to Chicago when it can be produced near at hand. The cost of transportation takes care of that. There is, therefore, no competition with the truck farmer of other areas. When they can fill the demand, the freights hauling iced cars stop running out of the West.

What has been said of vegetables, is true in large part of the fruits grown on irrigated lands in the West. The citrus fruits of California and Arizona are known the world over. Every spring in Washington, D. C., before the frost is out of the ground, big red cherries appear in the markets. The label of a shipper from an irrigated section out here appears on every box. As the season progresses, these western cherries are displaced by those grown near at hand. So it is with every other fruit. Fresh fruits are now available at reasonable prices the year round, thanks to irrigation in these western valleys where a warm sun compensates in part for a deficient water supply. When the advancing season ripens the fruit on the trees of the East, the remainder of the western crop is canned. Again we find the irrigated orchards complementing those of other regions.

I will only mention, without dwelling on the theme, that the Nation has a direct interest in the manner in which the irrigated districts bolster the local and State governments of the West. Mining once was the principal industry of the 100th meridian. Now the West is sprinkled with ghost towns which were abandoned when the ore veins pinched out. Irrigation farming has served to substitute for the vanishing resources. It not only has supplanted mining as a source of income in the Western States, but it has grown many times more productive of wealth. The irrigated districts support schools and churches. The Federal projects alone support 859 rural schools and 996 churches. These areas are pillars in the foundation of county, city, and State governments. The irrigated lands are carried on the tax rolls in most areas at valuations 10 or even 20 times as high as the valuations placed on dry-farmed lands. It must be remembered further that there are about 500,000,000 acres in these Western States that are federally owned and that therefore do not appear on the tax rolls at all.

Federal Reclamation not only has an important place in the Nation's land-use program—it is essential. It is vital to those whom it nourishes in distant parts. It is vital to those with whom nature has not dealt kindly elsewhere; those who seek security through new homes and new opportunities.

It is our responsibility to apply the knowledge that engineering and science now make available, for the benefit of all the people. Today we move forward in the construction of Grand Coulee Dam, the key structure of the greatest single irrigation project of history. To the limit of our ability, let us be worthy of our trust and meet the challenge of nature on the third of our Nation which is ill-watered.

Reclamation Commissioner Page Recommends Plan for Columbia Basin Development

FOLLOWING a series of conferences at Spokane, Wash., Commissioner of Reclamation John C. Page has recommended to landowners a 3-point program for the development of the 1,200,000-acre Columbia Basin project

Outstanding among the recommendations of the Commissioner were the organization of the entire project area into preferably one, but not more than two, irrigation districts; the enactment of State laws necessary to comply with Federal statutes and facilitate the program; the exclusion of existing towns and cities from irrigation districts; and the creation of machinery for excluding also towns that will grow up later on the project, so that control of the district will be vested in the rural population.

State legislation recommended for enactment would include the ratification of the antispeculation act to the extent that State jurisdiction and State lands are involved, provision for equitable representation for all parts of a district by authorizing the division of any district into five divisions and the election of one director from each division, and the limitation of assessments in any division to a low figure, perhaps 2 cents per acre per year until the actual construction of irrigation works in that division is initiated.

Mr. Page states that:

"The antispeculation law is a constructive piece of legislation, the principles of which have been applied successfully on projects elsewhere for a number of years, and have proved effective in providing for the disposal of excess holdings at fair values and in protecting settlers against inflated prices. The special problems of the large landowners have been adequately met by provisions in contracts entered into between the Government and the landowners and between the Government and irrigation districts. These contracts prevent operations under the law from becoming burdensome during the period prior to irrigation, and prior to the sale and development of excess lands.

"The time necessary for legal steps required for the organization and confirmation of districts, the negotiation, authorization and confirmation of contracts, and securing necessary State legislation, will be at best almost as much time as will be required for the completion of Grand Coulee Dam, and persistent and orderly effort to complete the district organization and comply with legislative requirements is necessary if interruptions of the construction program are to be avoided. During this period there will be sufficient time for a full and complete discussion and understanding of requirements and plans, and for the orderly organizing of the area.

"In the matter of education and organization, the Bureau of Reclamation will cooperate to the fullest extent, but the fact remains that the primary responsibility for organizing the district rests on the landowners. From them must come initiative and primary action.

"Also, I earnestly urge that the State lend official cooperation and leadership, and i

NOTES FOR CONTRACTORS

Specification No.	Project	Bids opened	Work or material	Low Bidder: Name	Low Bidder: Address	Bid	Terms	Contract awarded
750	Boulder Canyon, Ariz.-Nev.	Oct. 25	2 23,000-volt bus structures, two 138,000-volt disconnecting switches, and one transformer neutral bus structure for units A-6 and A-7.	I. T. E. Circuit Breaker Co.	Philadelphia, Pa	[1] $79,550.00	F. o. b. Boulder City	Dec. 18
				Bowie Switch Co	San Francisco, Calif.	[2] 2,155.00	do	Nov. 30
				I. T. E. Circuit Breaker Co	Philadelphia, Pa	[3] 805.00	do	Dec. 18
973-D	Riverton, Wyo.	Oct. 1	Drilling a water supply well at the Government camp at Pavillion.	Leslie E. Owen	Thermopolis, Wyo	1,330.00		Oct. 30
976-D	Boulder Canyon, Ariz.-Nev.	Oct. 7	Relay board for installation in 230-kilovolt switchyard at Boulder power plant.	Square D Co	Denver, Colo	1,235.00	F. o. b. Los Angeles, discount 2 percent	Nov. 3
977-D	Parker Dam, Ariz.-Calif	Oct. 13	160,000 barrels of low-heat portland cement.	Monolith Portland Cement Co.	Los Angeles, Calif	178,800.00	F. o. b. Monolith	Nov. 11
978-D	Boulder Canyon, Ariz.-Nev.	Oct. 15	Strainers, water jet eductors, water-pressure regulators, float cages with valves, and air-pressure relief valves for Boulder power plant.	Andale Co	Philadelphia, Pa	[1] 3,584.00	F. o. b. Boulder City	Oct. 27
				Schutte & Koertig Co	do	[2] 9,650.00	F. o. b. Philadelphia	Oct. 28
				Fisher Governor Co	Marshalltown, Iowa	[3] 842.20	F. o. b. Boulder City	Do
979-D	Kendrick, Wyo	Oct. 18	Bulkhead gates and bulkhead-gate-frame assemblies.	Berkeley Steel Constr. Co., Inc.	Berkeley, Calif	[4] 14,750.00	F. o. b. Berkeley	Nov. 10
				Consolidated Steel Corporation, Ltd.	Los Angeles, Calif	[5] 12,292.00	F. o. b. Los Angeles	Do.
980-D	All-American Canal, Ariz.-Calif.	Oct. 22	18 radial gates for power drops 2, 3, 4, and 5 and New Briar turnout	Do	do	[4] 8,060.00	do	Nov. 2
				Omaha Steel Works	Omaha, Nebr.	[5] 3,472.00	F. o. b. Omaha, discount ½ percent	Do.
				Lakeside Bridge & Steel Co.	Milwaukee, Wis	[6] 3,110.00	F. o. b. Milwaukee	Do
				Treadwell Construction Co	Midland, Pa	[7] 1,254.00	F. o. b. Midland, discount 1 percent	Nov. 1
981-D	do	Oct. 25	32 radial gates for Pilot Knob wasteway, New River turnout and various turnouts and checks.	Pacific Iron & Steel Co., Ltd	Los Angeles, Calif	22,717.00	F. o. b. Lynwood, Calif., discount ½ percent.	Nov. 20
984-D	Shoshone, Wyo.	Nov. 9	Transformers, lightning arrestors, air-break switch, expulsion fuses, and outdoor switching and metering equipment unit for Garland substation.	Wolff Electric Co	Portland, Oreg	[4] 1,918.00	F. o. b. Portland	Do
				Graybar Electric Co., Inc.	Denver, Colo	[5] 319.80	F. o. b. Garland, Wyo	Do
				do	do	[6] 10.95	do	Do
				Southern States Equipment Corporation.	Birmingham, Ala	181.70	do	Do
				Bowie Switch Co	San Francisco, Calif	[8] 132.20	do	Do.
				Kelman Electric & Manufacturing Co	Los Angeles, Calif.	[9] 1,911.50	do	Dec. 11
985-D	Minidoka, Idaho	Nov. 10	Transformers, oil circuit breakers and disconnecting switches for Minidoka power plant.	Pennsylvania Transformer Co.	Pittsburgh, Pa	[4] 13,520.00	F. o. b. Minidoka, Idaho.	Dec. 3
				Kelman Electric & Manufacturing Co.	Los Angeles, Calif	[5] 8,112.52	do	Do.
				The High Tension Co., Inc	Phillipsburg, N. J	[6] 778.50	F. o. b. Minidoka, Idaho; discount 1 percent	Do
988-D	Boulder Canyon, Ariz.-Nev.	Nov. 26	Steel cable racks and supports for Boulder power plant.	The Midwest Steel & Iron Works Co	Denver, Colo	5,882.00	F. o. b. Boulder City; discount ½ percent.	Dec. 1
989-D	do	Nov. 29	Structural steel for bus towers, center take-off structure, and lightning-arrester supports for Southern California Edison switching station and transformer circuits.	Lehigh Structural Steel Co.	New York, N. Y	6,110.00	F. o. b. Allentown, Pa.	Dec. 7
991-D	Owyhee, Oreg.-Idaho	Nov. 24	Plate-steel penstock and discharge pipe and appurtenances for Succor Creek pumping plant.	Beall Pipe & Tank Corporation	Portland, Oreg.	1,118.00	F. o. b. Portland.	Dec. 1
993-D	Yakima-Roza, Wash	Dec. 1	Radial gates and radial gate hoists for Pomona Siphon.	John W. Beam	Denver, Colo	[4] 1,410.00	F. o. b. Peotone, Ill., discount ½ percent	Dec. 9
				Valley Iron Works	Yakima, Wash	[5] 2,370.00	F. o. b. Yakima, discount 5 percent.	Do.
A-33,681-A	do	Nov. 8	Steel reinforcement bars (2,356,612 pounds).	Knoxville Iron Co.	Knoxville, Tenn	61,978.90	F. o. b. Moxee City, Wash., discount ½ percent b. p. v.	Dec. 3
A-42,382-A	All-American Canal, Ariz.-Calif.	Oct. 18	Steel reinforcement bars (3,800,000 pounds).	Tennessee Coal, Iron & R. R. Co.	Birmingham, Ala.	[1] 54,700.00	F. o. b. Knob, Calif	Dec. 10
						[2] 48,285.00	F. o. b. Calexico, Calif	Do
987-D	Colorado River, Tex	Nov. 29	Pipe fittings, valves, and appurtenances for paradox gates at Marshall Ford Dam.	C. J. Rainear & Co., Inc	Philadelphia, Pa	38,943.00	F. o. b. Chicago, discount 2 percent.	Dec. 20
990-D	Kendrick, Wyo	Nov. 30	Three 14- by 50-foot fixed-wheel gates for spillway at Seminoe Dam.	Phillips & Davies, Inc	Kenton, Ohio	37,000.00	F. o. b. Kenton, discount 1 percent.	Do.
992-D	Yakima-Roza, Wash	do	Structural steel for nine bridges on Yakima Ridge Canal.	The Midwest Steel & Iron Works.	Denver, Colo.	8,675.00	F. o. b. Moxee City, Wash., discount ½ percent.	Dec. 11
995-D	Sun River, Mont	Dec. 3	Clearing Gibson reservoir site above elevation 4,716.5.	Carl Teubert	Fairfield, Mont	4,494.00		Dec. 13
998-D	Blue River, South Platte, Colo.	Dec. 7	Geophysical survey of Leal and Dillon dam sites and of tunnel location.	Heiland Research Corporation.	Denver, Colo.	1,880.00		Dec. 11
33,683-A	Yakima-Roza, Wash	Nov. 29	42,000 barrels of portland cement in bulk and 2,000 barrels in cloth sacks.	Superior Portland Cement Co	Seattle, Wash	[1] 61,260.00	F. o. b. Seattle, discount 10 cents per barrel.	Dec. 20
						[2] 4,060.00	F. o. b. Seattle; discount and sacks, allowance 50 cents	

[1] Schedule 1. [2] Schedule 2. [3] Schedule 3. [4] Item 1. [5] Item 2. [6] Item 3. [7] Item 4. [8] Item 5. [9] Item 6.

need be physical and financial help, to the work of organizing the Columbia Basin district or districts. Since the development of the project is a matter of State-wide economic importance, such active cooperation on the part of the State administration is appropriate and proper.

"The surveys now being made of the Columbia Basin Project will include an investigation of the economics of pumping water from the Columbia River to lands in southern Franklin County as compared with watering them from the east canal, and the findings will be reported to residents of the areas concerned.

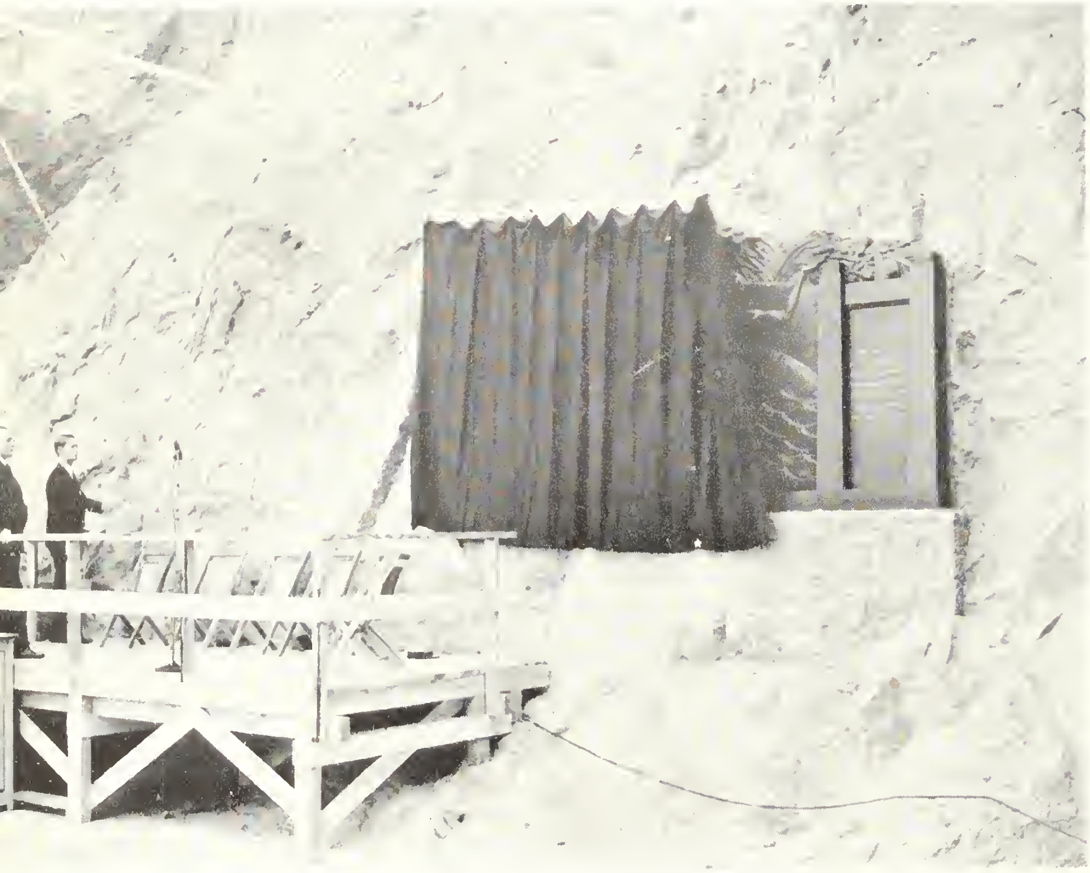
"The construction program for the canal system will be determined and made public well in advance of actual construction. Studies now under way have not yet gone far enough to determine the program. It will be based on economic and engineering considerations.

"An investigation will also be made of the feasibility of irrigating a considerable area of land in the western part of Walla Walla County.

"The course of the Bureau has not been and will not be determined arbitrarily. Painstaking efforts are made to find and weigh all pertinent facts, and to arrive at the program that will be best to further the development of the affected territory in accordance with the law."

* * * * *

Plaque Erected at Boulder Dam *Memorializes Workers*



Commissioner Page unveiling memorial plaque to labor.

A MEMORIAL to the workmen who built Boulder Dam was unveiled and dedicated in a ceremony at 11 a. m. December 17, 1937, on the Arizona side of the Colorado River at the dam.

John C. Page, Commissioner of Reclamation, represented the Department of the Interior and unveiled the bronze plaque after the American flag was raised for the first time over Boulder Dam. His address follows:

"Boulder Dam often is referred to as a great engineering achievement. I am an engineer and I am not slighting my profession when I say that Boulder Dam is an achievement in which free American labor can take equal pride. The man who drafted the blue prints, the foreman who directed the work, and the workman who tamped the concrete, together built Boulder Dam. It was a voluntary cooperation, and each was indispensable. Each should share alike in whatever honors are due.

"Boulder Dam, as we see it here in the depths of Black Canyon, with the Colorado River piled up for miles behind it in Lake Mead, is an inspiring and majestic sight. Personally, I take pride in the fact that I had a small part in its construction, and I am sure that all others who labored here must do likewise.

"Almost precisely the same quantity of masonry went into Boulder Dam as was placed in the great pyramid of Cheops in Egypt 3,000 years ago. In appearance, of course, and functionally as well, the two structures are totally dissimilar. The pyramid stands as a monument to a vain king. This dam will serve this and future generations in our democracy in many useful ways. The greatest difference, however, between Boulder Dam and the great pyramid is to be found, to my way of thinking, in the manner of their construction.

"The pyramid, we are told, required the labor of more than 100,000 slaves for 30 years—their working lives. About 4,000 free American workmen built Boulder Dam in 5 years, less 11 days. The advance of science and the machine are not alone responsible for this astounding difference. The skill, the energy and the spirit of the men who toiled willingly at Boulder Dam contributed in large measure.

"The people, who are the Government of the United States, insist that it shall protect and respect the rights of all its citizens. The manner in which those employed here responded in the construction of Boulder Dam is proof in itself of the wisdom of the democratic form.

"The United States cannot impress labor into its service to build tombs or dams. It holds, on the other hand, that every individual is entitled to a free choice of his lifework according to his desires and to his abilities.

Reclamation's Labor Policy

"Here, while paying tribute to the men who built Boulder Dam, and particularly to those who gave their lives in its construction, it seems appropriate to discuss the policy of the Bureau of Reclamation with regard to labor. I like to consider all who are engaged in this work as partners in our endeavor to develop the West, to conserve and control its waters, and to create new homes and new opportunities.

"The labor policy of the Bureau of Reclamation is founded on the acts of the Congress: which has declared that we shall permit no one, except in actual emergencies, to work more than 8 hours a day; which has required us to write into our contracts as the minimum rates of pay the prevailing wages of the locality in which the proposed work is to be done; and which has recognized and guaranteed labor the right to organize and bargain collectively.

"Generally the construction undertaken by the Bureau is let to contract, as it was here at Boulder Dam. In these instances, the Bureau officials do not deal directly with labor, but have certain responsibilities with respect to seeing that the contractors live up to the spirit and the letter of the law. Under certain conditions, however, the Bureau has built its canals and structures with Government forces. In these instances, the relationships with labor are much closer.

"Where contractors come between the Bureau and labor, the decision as to whether the work will be done on an open-shop or a closed-shop basis rests with the individual contractor. Jobs being done by Government forces must be performed on an open-shop basis. The reason for this is that the Government, no less than the men, must have freedom of action. To grant a closed shop on any work being done directly by the Government

would be to grant a sovereign power—that of saying who shall and who shall not work for the Government—to a group, which is clearly contrary to democratic principles.

"Dr. Arthur E. Morgan, chairman of the Tennessee Valley Authority, recently elaborated this idea by citing the following examples:

" 'Law schools may determine whom they will graduate, and bar associations may determine whom they will recognize, but if the people elect a prosecuting attorney, he can serve regardless of what law schools or bar associations may decide. Universities and educational associations cannot determine who may teach in the public schools. Only the Government or its authorized agencies can do that.

"The Department of the Interior, of which the Bureau of Reclamation is a part, will not permit discrimination by its officials and representatives among applicants for force account work on the grounds that the applicant is or is not a member of any organization.

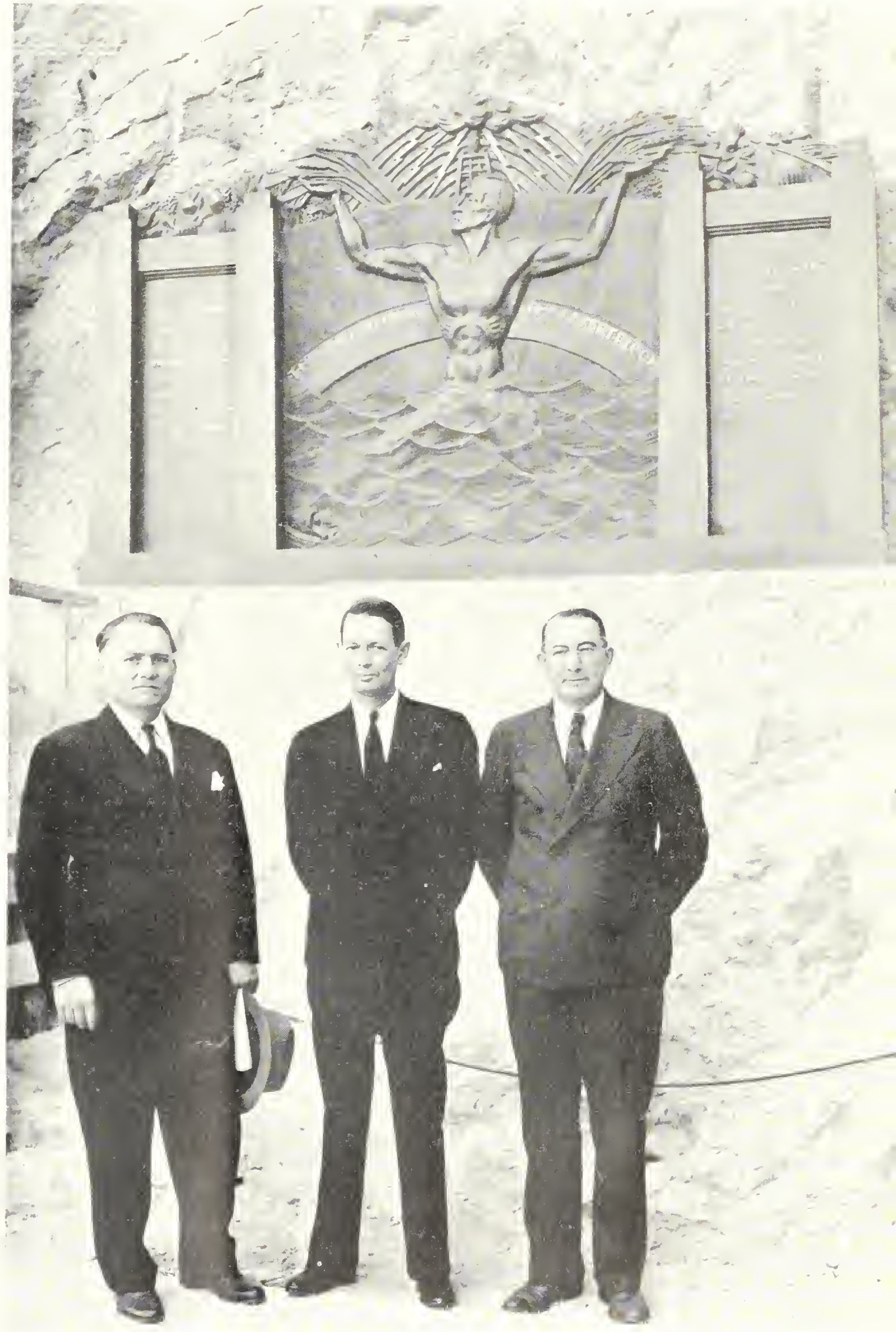
"Personally, I share the belief of nearly all those in responsible positions in the Government, that labor should be encouraged to form responsible organizations through which it may be represented in bargaining when employed on either private or public work. Bureau of Reclamation officials always are available to the men or to their representatives, and every case presented is handled impartially on its merits.

"The American workman has every right to be proud. His workmanship has no superior. Among the finest of his monuments we see here before us, Boulder Dam.

Boulder Dam Job Hazardous

"The men who built Boulder Dam were gathered from far and near. They made up a good cross-section of the crafts as well. They undertook a hazardous job in an out-of-the-way corner of the desert where the heat was terrific in the middle of the summer and where the winters as well were severe. They did it with enthusiasm.

"No major construction work of a more hazardous nature than that at Boulder Dam ever has been undertaken. Built in a rock-walled canyon, both narrow and very deep, Boulder Dam subjected the men who worked on it to risks which were many times magnified by its rugged setting. Men were dangled at the ends of ropes a thousand feet above the river, scaling off the loose rock. Here were driven four tremendous tunnels at the very bottom of the gorge, where tropic heat and the magnitude of the operations increased the dangers ordinarily attached to blasting, mucking, and lining such bores. The muckers, the pipefitters, the carpenters, the steel erectors, the concrete and clean-up crews worked elbow to elbow in close confinement on the rising piers of the dam while overhead more than 3,000,000 cubic yards of concrete was moving in buckets suspended by steel strands. Truck



Left to right: Oskar J. W. Hansen, Sculptor; John C. Page, Commissioner of Reclamation; Ralph Lowry, Construction Engineer.

drivers wound their heavy equipment up construction roads with which, by comparison, the highway to the top of Pikes Peak was a bridle path. Sections of steel pipe, 30 feet in diameter and weighing more than 150 tons, were swung down by cable hauled through narrow apertures in the cliffs to be fitted to-

(*Concluded on page 10*)

DAM CONSTRUCTION

in Progress at the Beginning of 1938

By W. I. SWANTON, *Associate Engineer, Washington Office, Bureau of Reclamation*

(See groups of dams on opposite page and back cover)

Name	Project	State	Percent complete Dec. 31	Estimated date of completion
Alcova	Kendrick	Wyoming	95	1938
Bartlett	Salt River	Arizona	33	1939
Boca	Truckee Storage	California	25	1938
Bull Lake	Riverton	Wyoming	90	1938
Caballo	Rio Grande	New Mexico	66	1938
Fresno	Milk River	Montana	25	1939
Grand Coulee	Columbia Basin	Washington	30	1941
Grassy Lake	Upper Snake	Idaho	22	1938
Imperial	Boulder	Arizona-California	90	1938
Island Park	Upper Snake	Idaho	85	1938
Marshall Ford	Colorado River	Texas	25	1939
Moon Lake	Moon Lake	Utah	95	1938
Parker	Parker	Arizona-California	90	1938
Seminoe	Kendrick	Wyoming	50	1938
Unity	Burnt River	Oregon	99	1938
Vallecito	Pine River	Colorado	0	1941

THE signing of the second contract for the completion of the construction of the Grand Coulee Dam insures the continuation of work on the largest dam in the world and the employment of 6,000 to 8,000 men on this project.

In addition to this dam on the Columbia River the Bureau of Reclamation has under construction at the present time about 15 dams in the Western States, including the following:

Alcova Dam.—This is an earthfill structure with rock face located on the North Platte River in the State of Wyoming, with a maximum height of 232 feet, a length of 900 feet, and a volume of 1,500,000 cubic yards. It is a combined storage and diversion dam forming a reservoir with an area of 2,235 acres and a capacity of 165,700 acre feet. It will be completed in the early part of 1938. (Illus. 1.)

Bartlett Dam.—This is a multiple-arch concrete dam, located on the Verde River in Arizona, with a volume of 162,825 cubic yards, a maximum height of 270 feet, and a length of 930 feet. It will form a reservoir with an area of 3,200 acres, and a capacity of 200,000 acre feet for storage of water for lands in the Salt River Valley. The dam is about 33 percent completed. (Illus. 2.)

Boca Dam. This dam is located on the Little Truckee River near the Nevada line in the State of California and will store water for the project lands in the State of Nevada. The dam is an earth fill structure with rock face, having a maximum height of 110 feet, length of 1,650 feet, and volume exceeding a million cubic yards, and will form a reservoir with a capacity of more than 40,000 acre-feet. The outlet tunnel has been excavated and the dam is about 25 percent completed. (Illus. 3.)

Bull Lake Dam.—This dam is located on Bull Lake Creek, a tributary of the Wind River, about 10 miles northwest of Riverton. It is an earth-fill structure with rock face, having a height of 75 feet, length of 3,400 feet, and a volume of 844,000 cubic yards, forming a reservoir with a capacity of 155,000 acre-feet. The dam is more than 90 percent completed and should be finished early in 1938, enabling it to be utilized for storage purposes during the coming irrigation season.

Caballo Dam.—This dam, located on the Rio Grande below the Elephant Butte Dam, will store about 350,000 acre-feet and aid in solving the storage and power problem on that international stream. The dam is an earth-fill structure with rock face and has a height of 90 feet, length of 4,250 feet, and consists of a million and a third cubic yards of material. The structure is about two-thirds completed. (Illus. 4.)

Fresno Dam.—This dam is an earth-fill structure located on the Milk River in Montana near the Canadian boundary and will form a reservoir with capacity of 127,000 acre-feet. The dam has a volume of nearly 2,000,000 cubic yards, and the work is about one-fourth completed. (Illus. 5.)

Grand Coulee Dam.—This will form the largest structure ever built by man with an ultimate volume in excess of 10,000,000 cubic yards of concrete and a maximum height of 550 feet. The storage capacity will be more than 5,000,000 acre-feet and the reservoir will extend to the International Boundary. The dam is about one-third completed, and the most difficult part of excavation and river diversion has been accomplished with most of the foundation concrete in place. (Illus. 6.)

Grassy Lake Dam.—This is an earth-fill structure with rock face, having a maximum height of 120 feet, a length of 1,200 feet, and a volume of about 600,000 cubic yards. It will form a reservoir with an area of more than 300 acres for storing approximately 15,000 acre-feet of water in the Upper Snake River storage basin. The dam is about 20 percent completed and will be finished early in 1938. (Illus. 7.)

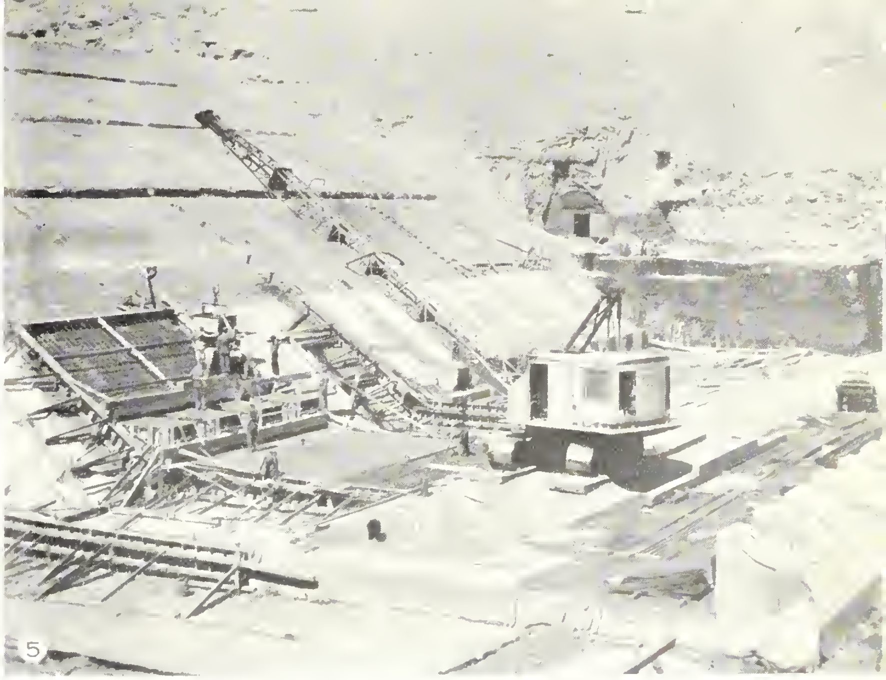
Imperial Dam.—This is a unique type of structure of concrete for diverting the waters of the Colorado to the All-American Canal, and in connection with it, extensive desilting works have been built to eliminate silt from the irrigation canal. The work is over 80 percent completed and should be finished early in 1938. (Illus. 8.)

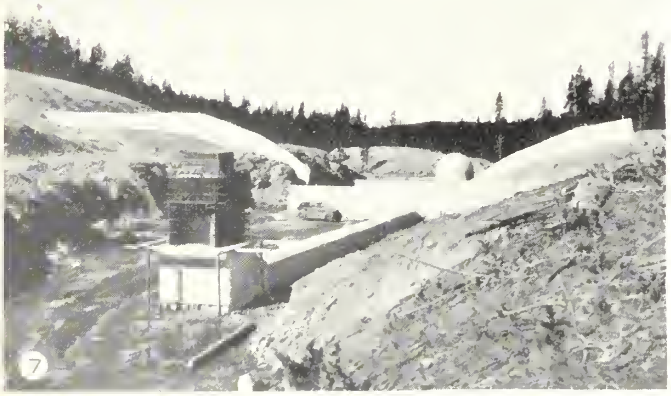
Island Park Dam.—The dam is located on Henry's Fork, a tributary of Snake River in the extreme eastern part of Idaho near the Yellowstone Park, and will store over 100,000 acre-feet of water for the lands under irrigation along the Snake River. The dam is an earth-fill structure with rock face, a volume of nearly 600,000 cubic yards, and a maximum height of 85 feet. (Illus. 9.)

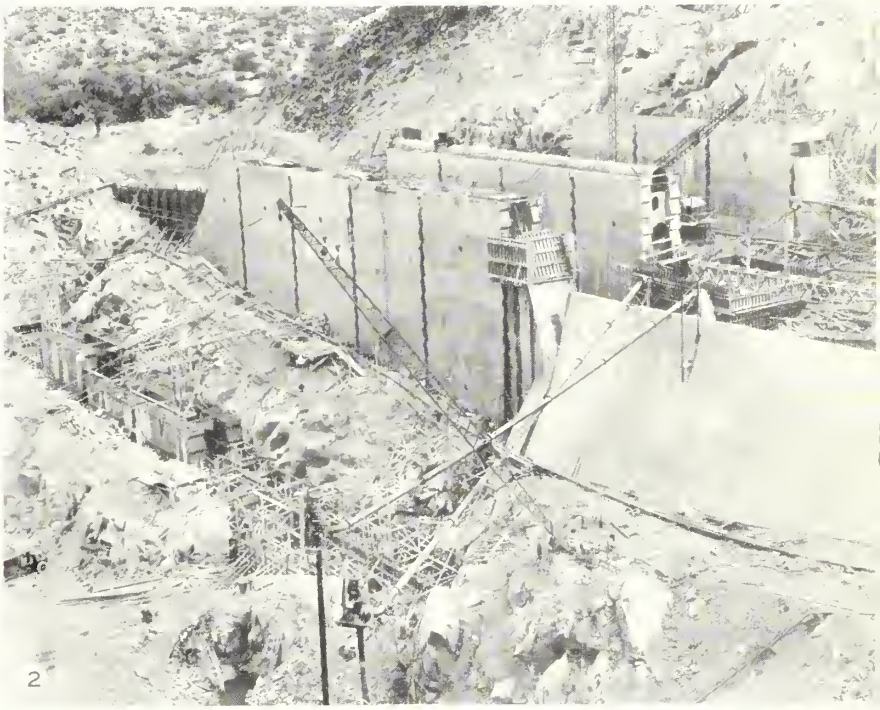
Marshall Ford Dam.—This dam, located on the Colorado River of Texas, northwest of Austin, is a concrete gravity structure with a height of 190 feet, a length of 3,380 feet, and a volume of more than 1,000,000 cubic yards, including earth dike. The present development will store 710,000 acre-feet and the ultimate proposed construction will provide for a storage of 3,000,000 acre-feet. The present development is about one-fourth completed and over 1,000 men are employed. (Illus. 10.)

Moon Lake Dam.—This dam is very nearly completed. It is located in northeastern Utah near Duchesne at the outlet of Moon Lake. It is an earth fill embankment with rock face, 110 feet high, 1,120 feet long, and a volume of more than 500,000 cubic yards. It will be practically completed by the end of the year and have a storage capacity of 30,000 acre-feet. (Illus 11.)

Parker Dam.—This structure, located on the Colorado near Parker, Arizona, is distinctly unique in having the deepest foundation ever excavated for a dam, extending to 235 feet below the river bed. The dam is being constructed to divert water to the Metropolitan Aqueduct and has a maximum height of 320







See article on opposite page.

feet. The construction, which is giving employment to nearly a thousand men, will be completed early in 1938. (Illus. 12.)

Seminoe Dam. This dam is located in Granite Canyon of the North Platte River about 33 miles north of Rawlins, Wyo., and will form a reservoir with storage capacity of nearly 1 million acre-feet for irrigation, river regulation, and power development. It is a concrete variable radius arch structure with maximum height of 265 feet and is about 50 percent completed. (Illus. 13.)

Unity Dam. This is an earthfill dam with rock face located on the Burnt River, a tributary of the Snake River in eastern Oregon and forms a storage reservoir with a capacity of 25,260 acre-feet. (Illus. 14.)

Vallecito Dam. This is to be an earthfill structure with a maximum height of 125 feet, length of about 4,000 feet, and a volume of nearly 3½ million cubic yards. It is located on the Vallecito Creek, a tributary of the Animas River in southwestern Colorado about 20 miles from Durango. It will form a reservoir of 123,000 acre-feet capacity for irrigation of lands on the Pine River project. Bids were opened for this dam on December 16, and it is estimated that the dam will not be completed until 1941.

This construction program is employing 20,000 to 25,000 persons and will aid in the development of many irrigation projects in the arid States of the West.

LAKE MEAD
to Become Famous Yachting Resort

ACCORDING to a recent press report "Lake Mead will one day be one of the most famous yachting spots in the entire world. It is the only place in the United States now where this great sport—enjoyed largely by the Nation's wealthy sportsmen—is possible during the winter months. It won't be long until you'll find hundreds of millionaires heading this way every year to play on your marvelous lake."

This was the statement made by James L. Breese, president of the Oil Devices Co., who has launched on the lake a 48-foot sailboat. In addition to the sailboat, which may be used for cruising or racing, Mr. Breese brought with him a motorboat and a small, twin-pontoon seaplane. The sailboat *Loli* is reported to have won many races in the 8-meter class along the eastern coast. Mr. Breese feels that conditions are right on Lake Mead for sailing, but plans to approve or disapprove his opinion with his *Loli.*

Mr. Breese resides in Santa Fe, New Mexico, and plans to fly back and forth, spending considerable time in the vicinity of Lake Mead this winter.

Parker Dam and trashrack structure shown from above Arizona abutment.

Plaque at Boulder Dam

(*Concluded from page 7*)

gether in the tunnels within. All these operations, and many more, required a high degree of alert bravery.

"Every precaution was taken to provide safety, but it was unavoidable that there should be casualties. Accidents did occur, and men were injured and some died. It is to the everlasting credit of the men at Boulder Dam that they accepted the challenge of the job itself with gallant courage. They overcame the difficulties it presented and they saw it through to completion, winning the admiration of the constructors of the world with the efficiency and speed of their work.

"In tribute to these men and to their fellows who made the supreme sacrifice that this dam might be built, I dedicate this memorial that it may stand here for all to see against this permanent rock overlooking Boulder Dam; I dedicate it in the name of a grateful Government."

Others taking part in the ceremony were Ralph Lowry, Construction Engineer, Bureau of Reclamation, in charge of Boulder Dam, and Oskar J. W. Hansen, sculptor, who designed the memorial plaque and the flagpole group.

The plaque is more than 11 feet wide and is set in the solid rock of the Arizona cliff of Black Canyon, overlooking the dam itself. Across the river, on the Nevada side, at the level of the crest of the dam, which rises 726.4 feet above the lowest point of its foundation, is the flagpole group. This group includes a 125-foot steel flagpole on a semicircular granite base, with a great winged figure at either side. These figures, cast in bronze, are 30 feet high.

The inscription at the base of the flagpole reads:

> "It is fitting that the flag of our country should fly here in honor of those men who, inspired by a vision of lonely lands made fruitful, conceived this great work and of those whose genius and labor made that vision a reality."

The memorial plaque bears the inscription: "They died to make the desert bloom," in large letters across its face. At either side are panels bearing inscriptions. The panel at the left says: "The United States of America will continue to remember that many who toiled here found their final rest while engaged in the building of this dam," and that at the right reads: "The United States of America will continue to remember the services of all who labored to clothe with substance the plans of those who first visioned the building of this dam."

• FINGERLINGS •

FIFTY thousand fingerlings from the State hatchery were planted in the Agency Valley Reservoir (Vale project, Oregon) during the month of October.

Spread of Work on BOULDER DAM

All but two of the 48 States contributed toward the construction of this dam

THE EAST as well as the West, in fact the entire country benefits by the construction of Boulder Dam. A tabulation of the expenditures for materials and supplies for the Boulder Dam under the Six Companies contract is given for the dam herewith. It will be noted that less than half of the expenditures were made in California, the two next largest were in the States of Pennsylvania and New York.

BOULDER CANYON PROJECT

SPREAD OF WORK

State	Government	Six Companies, Inc.	Total
Alabama	$1, 228, 055	$121	$1, 228, 176
Arizona	20, 849	291, 595	312, 441
Arkansas	686	......	686
California	10, 290, 124	7, 105, 410	17, 395, 564
Colorado	625, 350	87, 380	712, 730
Connecticut	58, 731	11, 756	70, 490
Delaware	1, 261	....	1, 261
Georgia	102, 321	....	102, 321
Idaho	4, 746	4, 160	8, 906
Illinois	832, 033	720, 041	1, 552, 074
Indiana	190, 726	374, 685	565, 411
Iowa	31, 760	1, 677	33, 437
Kansas	20, 790	...	20, 790
Kentucky	7, 531	....	7, 531
Louisiana	806	....	806
Maine	2, 601	....	2, 601
Maryland	17, 678	215, 041	232, 719
Massachusetts	1, 168, 282	10, 820	1, 179, 102
Michigan	969, 090	185, 154	1, 154, 244
Minnesota	75, 193	36, 522	111, 715
Mississippi	....	8	8
Missouri	343, 782	90, 853	434, 635
Montana	319	....	319
Nebraska	11, 937	617	12, 554
Nevada	674, 215	62, 167	736, 687
New Hampshire	125	....	125
New Jersey	242, 886	729, 112	972, 298
New Mexico	113	3, 005	3, 118
New York	1, 465, 803	784, 125	2, 250, 228
North Carolina	21	....	21
Ohio	413, 477	736, 692	1, 150, 169
Oklahoma	988	25	1, 013
Oregon	69, 518	701, 837	771, 355
Pennsylvania	3, 682, 631	343, 768	4, 026, 399
Rhode Island	16, 669	....	16, 669
South Carolina	355	....	355
South Dakota	39	....	39
Tennessee	15, 669	6, 802	22, 471
Texas	2, 845	2, 032	4, 877
Utah	1, 467, 660	151, 596	1, 619, 256
Vermont	267	....	267
Virginia	152, 226	19	152, 245
Washington	99, 981	93, 344	193, 325
West Virginia	65, 686	146	65, 832
Wisconsin	1, 915, 563	265, 357	2, 180, 920
Wyoming	27, 479	....	27, 479
Total	26, 318, 870	13, 016, 797	39, 335, 667

Expenditures in the 10 States in which more than $1,000,000 was expended are as follows:

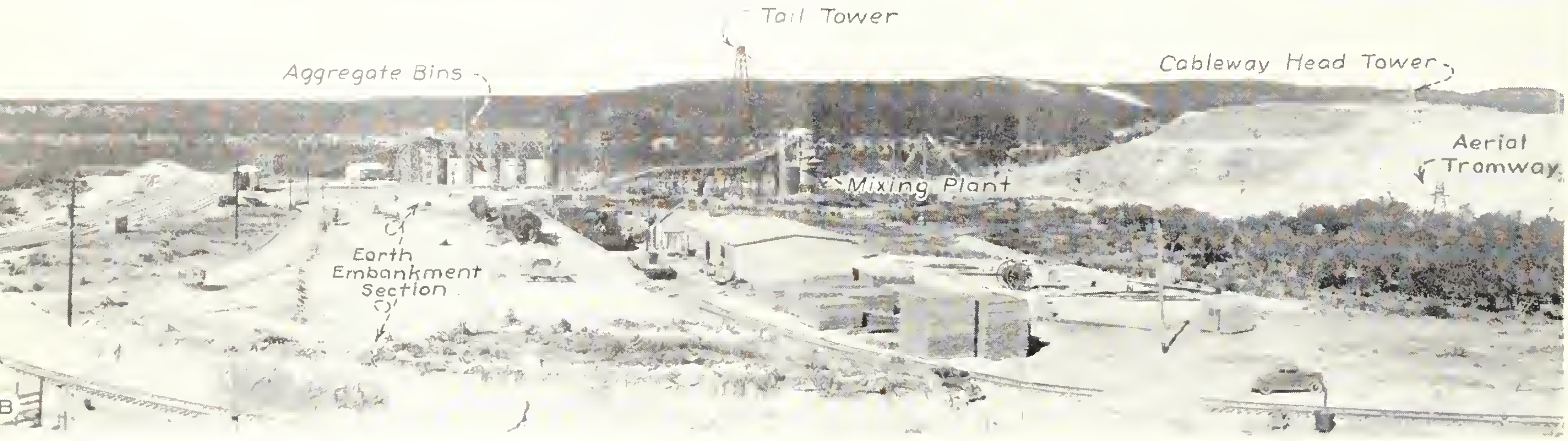
California	$17, 395, 564
Pennsylvania	4, 026, 399
New York	2, 250, 228
Wisconsin	2, 180, 920
Utah	1, 619, 256
Illinois	1, 552, 074
Alabama	1, 228, 176
Massachusetts	1, 179, 102
Michigan	1, 154, 244
Ohio	1, 150, 169

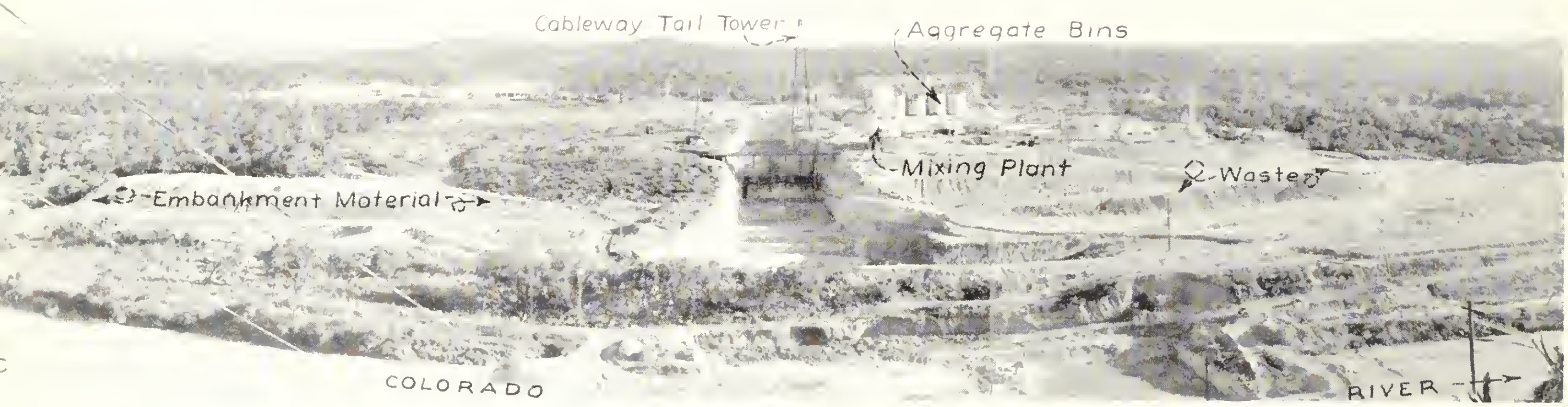
Power plants operated on Bureau of Reclamation projects during fiscal year 1936–37

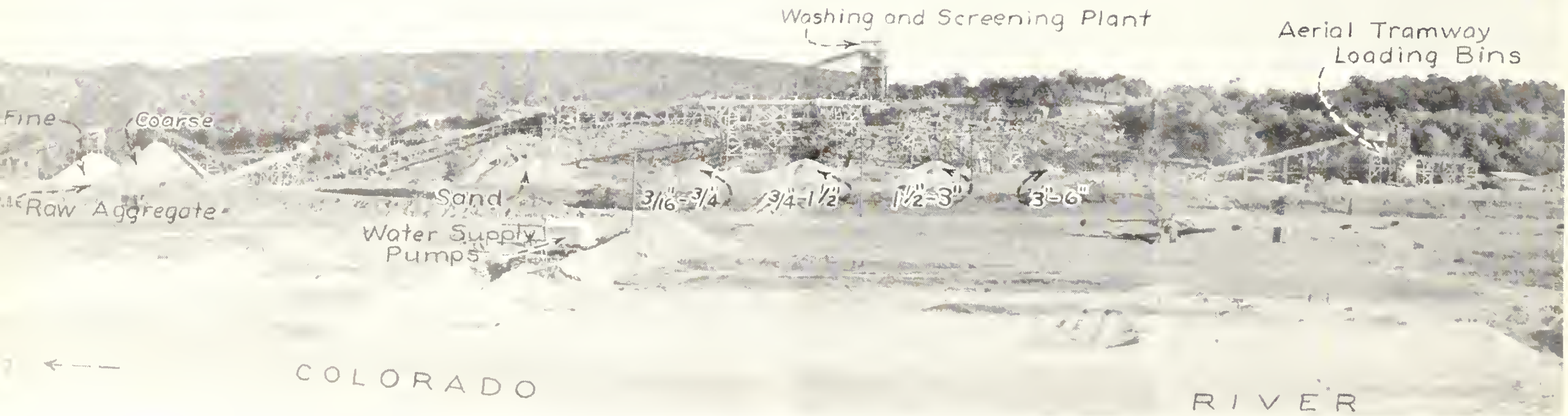
Project	Name of plant	Outgoing line voltage	Plant capacity (kilovolt-amperes)	Number of units	Head in feet	First cost of plant (all features)	Cost of operation and maintenance without depreciation (all features)	Estimated depreciation	Cost per kilowatt-hour, exclusive of depreciation	Distribution of kilowatt-hours generated: Sold to consumers (kilowatt-hours)	Irrigation and drainage requirements (kilowatt-hours)	Used for other purposes (kilowatt-hours)	Losses (kilowatt-hours)	Total output (kilowatt-hours)	Gross power sales
Boise	Black Canyon	66, 000	10, 000	2	75.4 to 96.7	$414, 317. 21	$12, 888. 12	None	$0. 00027	19, 901, 521	25, 347, 837	1, 675, 101	1, 531, 119	[2] 48, 455, 578	(1)
	Boise River	22, 000	1, 875	3	24.9	167, 905. 37	2, 450. 09	None	. 0009	(3)	(3)	(3)	(3)	(3)	
Boulder Canyon	Boulder	33, 000; 138, 000; 287, 500	[5] 376,000	[6] 7	453 [7]	[6] 28,736, 786. 00	(8)	(8)	(8)	577, 245, 539	None	10, 448, 495	6, 668, 966	594, 363, 000	$399, 278. 56
Grand Valley	Grand Valley	2, 300	3, 750	2	73 to 79	210, 500. 00	(4)	(4)	(4)	(4)	(4)	(4)	(4)	5, 506, 540	(4)
Minidoka	Minidoka	33, 000	10, 000	6	46.89 average; 50 maximum	1, 110, 195. 86	[11] 128, 199. 19	[12] $39, 110. 00	. 0018	22, 586, 568	33, 858, 132	9, 798, 872	4, 077, 479	[13] 70, 321, 051	196, 831. 72
	American Falls [14]	33, 000	540	1	44	76, 975. 00		(15)							
Newlands	Lahontan	66, 000; 33, 000; 2, 300	1, 875	3	110–20	324, 793. 52	16, 467. 44	7, 619. 84	. 0047	2, 196, 600	55, 946	829, 018	388, 596	3, 500, 860	34, 614. 25
North Platte	Guernsey	33, 000	6, 000	2	70–90	454, 244. 27	14, 844. 83	[16] None	. 0011085	21, 863, 637	None	373, 255	1, 806, 198	13, 391, 300	241, 698. 40
	Lingle	33, 000	1, 750	4	106	184, 791. 74	10, 611. 01	[17] None	. 0010105	(18)		(18)	(18)	10, 530, 890	(18)
Rio Grande	Elephant Butte	2, 300	150	1	18 to 180	8, 440. 50	2, 398. 48	None	. 0067	None	None	356, 890	(19)	356, 890	None
Riverton	Pilot Butte	33, 000; 2, 300	2, 000	2	100 average	262, 809. 00	16, 348. 99	[20] None	. 011145	1, 001, 583	None	385, 137	80, 150	1, 466, 870	21, 529. 05
Salt River	Roosevelt	110, 000	19, 250	7	70 to 240	1, 372, 193. 73	38, 432. 43	68, 609. 70	. 000615					62, 425, 000	
	Horse Mesa	110, 000	33, 300	3	265	982, 756. 47	49, 574. 63	49, 137. 82	. 000420					118, 100, 000	
	Stewart Mountain	45, 000	13, 000	1	35–114	344, 070. 32	10, 892. 53	17, 203. 51	. 000312					34, 900, 000	
	Mormon Flat	110, 000	8, 750	1	40–150	472, 011. 68	19, 403. 66	23, 600. 58	. 000509					38, 158, 000	
	Cross Cut	11, 000; 40, 000	5, 250	6	111	663, 920. 33	29, 920. 47	33, 196. 02	. 002167					13, 809, 950	
	South Consolidated	40, 000	2, 000	2	34	176, 202. 81	9, 325. 88	8, 810. 14	. 000985					9, 471, 400	
	Arizona Falls	11, 000	1, 060	2	19	115, 566. 47	7, 882. 09	5, 778. 32	. 002398					3, 286, 500	
	Chandler	11, 000	600	1	40	177, 410. 37	7, 791. 00	8, 870. 52	. 002071					3, 762, 800	
	Total									[21] 332, 186, 018	[21] 37, 643, 856	[21] 349, 091	[21] 56, 314, 528	[22] 426, 493, 493	[21] 3, 345, 482. 05
Shoshone	Shoshone	33, 000	7, 000	3	220	883, 037. 48	15, 333. 80	[23] None	. 00155	8, 535, 644	None	173, 239	1, 169, 117	9, 878, 000	97, 529. 63
Strawberry Valley	Spanish Fork	11, 000	1, 000	2	123.5	137, 056. 11	[24] 15, 375. 84	[25] None	[26] . 0019	5, 331, 234	None	54, 247	247, 066	[27] 4, 986, 757	51, 491. 72
Yakima: Kennewick Division	Prosser	66, 000	3, 000	1	40	404, 843. 88	23, 757. 01	[28] None	. 00118	[29] 19, 976, 022	None	39, 458	266, 410	20, 281, 890	30, 756. 95
Sunnyside Division	Rocky Ford	6, 600	187	1	73	23, 000. 00	1, 925. 08	1, 056. 40	. 0028	None	686, 600	None	(4)	686, 600	None
Yuma	Siphon Drop	33, 000	2, 000	2	9.76 average; 15.50 maximum	364, 886. 00	14, 955. 68	8, 535. 00	. 001932	[30] 6, 709, 678	957, 445	72, 310	381, 583	8, 102, 616	42, 953. 20

1 To Idaho Power Co.; T. E. Connolly, Inc., and Lackey Gravel plant.
2 Includes Boise River power plant.
3 Included with Black Canyon power plant.
4 Not reported.
5 Installed to June 30, 1937.
6 Including two 3,000-kilovolt-ampere station service units.
7 June 30, 1937.
8 Not available.
9 Operated by contractor.
10 None—constructed with advanced funds.
11 Includes $50,000 charged for conserving water for American Falls reservoir.
12 $1,366 charged to operation and maintenance.
13 Includes 16,035,051 kilowatt-hours from Idaho Power Co.
14 Has not been operated since 1927.
15 Present nominal value.
16 $8,034 charged to operation and maintenance cost.
17 $5,200 charged to operation and maintenance cost.
18 Included with Guernsey power plant.
19 Unknown.
20 $7,800 charged to operation and maintenance.
21 Total for system.
22 Total for system including 142,579,593 kilowatt-hours purchased power.
23 $28,787.40 charged to operation and maintenance.
24 Includes power purchased, cost of which is $5,891.41.
25 $4,083.42 charged to operation and maintenance.
26 Cost including depreciation is $0.00272 per kilowatt-hour.
27 Excluding 645,790 kilowatt-hours purchased.
28 $9,000 charged to operation and maintenance.
29 Includes 5,108,500 kilowatt-hours of winter power delivered to Pacific Power & Light Co. in payment for transmission of power to irrigation districts.
30 Includes 1,402,000 kilowatt-hours used on Yuma Auxiliary project for irrigation pumping.

First Concrete Placed in the Marshall Ford Dam, Colorado River Project, Tex.







Marshall Ford Dam, Colorado River Project, Texas. B—View taken from tip of embankment section on left abutment. C—View of left abutment of dam, taken from high bluff on right side of river. D—Aggregate plant—Horseshoe Bend deposit.

THE first concrete was placed in the Marshall Ford Dam on October 30, 1937, by contractor Brown & Root, Inc., and McKenzie Construction Co., thus marking a step in the progress of this important feature of the project. The present development estimated to cost more than $10,000,000 will contain approximately 1,000,000 cubic yards of concrete and is scheduled for completion during July 1939.

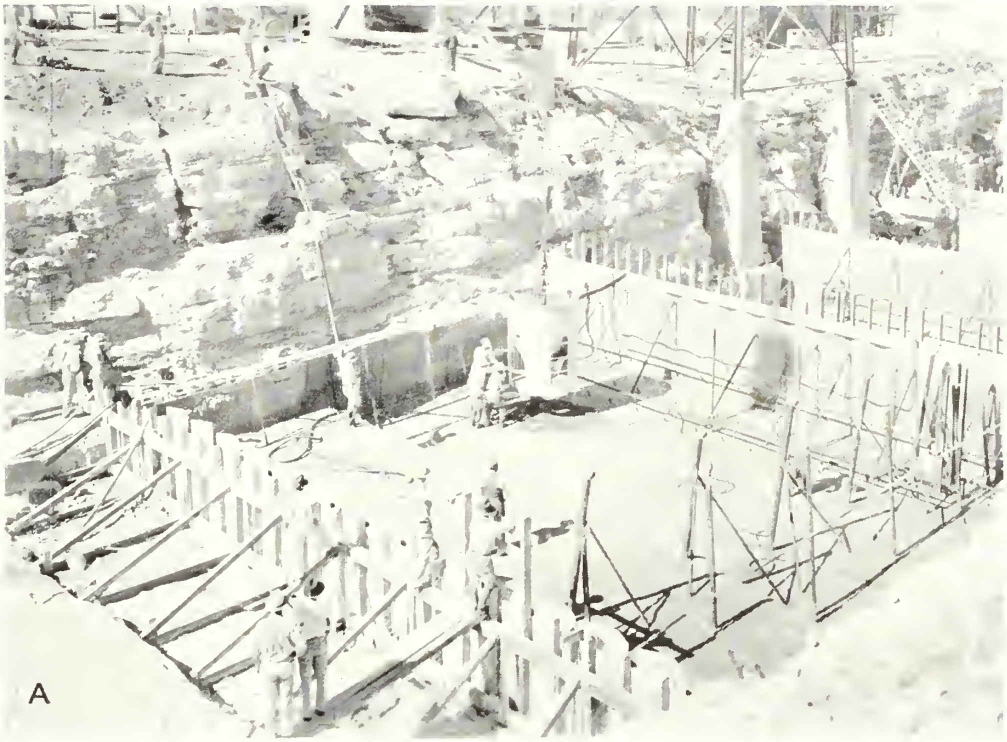
On November 1, 1937, the contract was approximately 20 percent complete on a cost basis with 320,732 cubic yards of common excavation, 164,401 cubic yards of rock excavation, and 7,082 cubic feet of pressure grouting—the main items of work accomplished.

The principal features in the construction plant which is nearing completion are an aerial tramway about 1.5 miles long for transporting aggregates from the gravel-processing plant; a complete gravel washing and classifying plant, a mixing plant consisting of seven bins, automatic weighing and batching devices, four 2-yard tilting mixers, and 4- and 8-yard concrete buckets; a 2,000-foot span 20-ton movable cableway and a stiff-leg derrick with a 185-foot boom. A railway spur 14 miles long connects the job with the Southern Pacific line at Rutledge, Tex. All heavy machinery, cement, and miscellaneous materials, as well as a large quantity of crushed aggregate size 3 to 6 inches, will be moved over this spur.

As shown in photo "A," the first concrete is being placed with a stiff-leg derrick. All concrete in blocks 1 to 7, inclusive, covering a distance of some 400 feet from the left end will be placed in a similar manner.

At present, work is progressing on a three-shift basis with approximately 695 men employed.

The progress made in the construction can be seen by comparing photos "B," "C," and "D" with those published in the April issue of the Reclamation Era, pages 69 and 71, and on page 183 of the August issue.



Concrete being placed in Block F, on left abutment.

Colorado-Big Thompson Project Approved

UNDER date of December 28, 1937 Secretary of the Interior Ickes announced that President Roosevelt had approved a finding of the Secretary that the Colorado-Big Thompson Transmountain diversion project is feasible. The approval of the finding is the final step preliminary to the start of construction. Although Congress appropriated for initiation of the work last summer, the law requires that the Secretary of the Interior make a finding of feasibility and that such finding be approved by the President as the last step in authorization of Federal reclamation projects.

The costs of all power plants and other features properly allocable thereto will be paid from power revenues. The costs properly chargeable to irrigation will be repaid in 40 years, without interest, under contracts negotiated by the Bureau of Reclamation with a responsible organization in the project area, under the reclamation law. The total estimated cost of original construction is $13,702,772. Of this cost $6,902,772 has been tentatively allocated to the power development, leaving $21,800,000 to be repaid by the irrigation interests.

The Secretary states that he has given due consideration and sympathy to those who opposed the project on the ground that it might injure or impair Rocky Mountain National Park and be a precedent for despoiling our national parks. He assures the opponents that such will not be the case. The present plans protect the park from injury and some benefits are secured by the park.

A full description of the project was given in the October 1937 issue of the ERA.

ANNUAL REPORT

of the Secretary of the Interior for the Fiscal Year 1937, 410 pages

THIS report contains a summary of the outstanding activities of the Interior Department, discussing land and water uses, grazing program, the record in reclamation, the Antiland Speculation Act, record of the Park Service and discussing conservation by the Indian Service, petrolium conservation, mine safety work, cooperation of the Conservation Corps and recommendation for a Department of Conservation.

The report includes (pp. 1–33) the Thirty-sixth Annual Report of the Bureau of Reclamation under Commissioner John C. Page. It discusses the demand for new lands, the construction program including the Grand Coulee Dam, Boulder Canyon and Central Valley projects, and contains the settlement, crop, and financial tables. The total land now under irrigation including the area supplied by the Federal storage reservoirs is now over 3,000,000 acres, and there are more than 850,000 persons residing on the farms or in the projects' cities and towns.

Small Transparencies Available at Little Cost

THE Bureau is in a position to furnish transparencies 5 x 7 of any vertical views from negatives in its files, attractively framed, for $2 each.

These transparent views are made on translite film and colored in oil, then placed in a very narrow chromium standing frame. The frame is so constructed with springs that it is removable in a few seconds. The whole thing makes a very pleasing appearance.

The Bureau will, on request, send photographs for selection of a view, and orders should be accompanied by personal check or money order made payable to the Bureau of Reclamation.

What Trees Have Done for A. E. Scott in the GREAT PLAINS AREA

By R. B. BALCOM, *Senior Foreman, CCC Camp BR-1, Minatare, Nebr.*

Mr. Scott's original windbreak planted in 1921. This belt has saved tons of crops and conserved many acre-feet of water.

WIND-TORN fields now remind us
We should "plant" our lands to stay,
And departing leave behind us,
Fields that have not blown away.
When our sons assume the mortgage
On the land that's known our toil,
They'll not have to ask the question,
"Here's the farm, but where's the soil?"

When A. E. Scott landed, in 1920, on an 80-acre unit of the Pathfinder irrigation district, he landed amid "wind-torn fields", cactus, and blow-out holes. It was probably one of the worst run-down units on the project. His friends told him that he would never make the farm pay. But with the hope ever present in the heart of a pioneer he, his wife, and their son Charles, decided, to "do or die." At first it looked like "die." Starting with only a few pieces of machinery, two horses, about a dozen chickens and three goats was discouraging. With what tools he had he worked down the largest piles of sand so the ground could be irrigated. Neighbors, watching his efforts, laughed because they knew what would happen to this sandy unit when the spring winds reached their height. They were right. The first crop planted, corn, was sand blasted and cut off when about 4 inches high. Mr. Scott's ground was sandy; but it was not alone, as much of his neighbors' land blew also. Why shouldn't it blow in a vast prairie region where the three principal causes existed—sandy soil, wind, and nothing to break the wind? So his neighbors' sand blew over and cut off the young tender shoots.

The pioneer spirit again surged to the surface. Mr. Scott saw that he yet had time to raise a crop of beans. He worked early and late preparing his seed bed and planting the beans. He irrigated and tended them faithfully, and a good stand seemed to be assured. But even though they were watered well, the hot, drying winds caused much rapid evaporation. About half a crop was finally cut and piled ready to be hauled to the threshing machine. Again the wind played an unforseen hand. This time sand was drifted over the piles so badly that much of the crop was lost, to say nothing of the work involved to dig the piles out.

To some this might sound like a hopeless piece of ground, fit only for cactus, jackrabbits, and rattlesnakes, but although the ground is light and sandy, the soil is fertile and irrigation water is available.

Trees Grown in Plains Area

Now, Mr. Scott came from a tree country, Ohio, and his thoughts turned to trees for protection. It wasn't a new idea to use them for a windbreak, but many thought trees would not grow in the Plains area, except along rivers; Mr. Scott was willing to try. The next spring, with the help of Mrs. Scott, he took a team and buggy and went to the North Platte River, a round trip of more than 30 miles, and hauled home hundreds of cottonwood seedlings. He planted them on the west side of the field that was so badly blown. An old grove at the house, the only trees on the place, protected the field some from the north. He tried farming again, this time only in the lee of his trees. He noticed some difference from the very beginning. The next spring, and many springs following, the Scotts went to the river and brought back trees to protect other fields.

Today he has one of the finest farms, now increased to 160 acres, in the locality and he gives all credit to his windbreaks. He has made a practice of watching the dust-laden currents and thereby tracing the path of the wind over his farm. This has shown him the areas needing further protection.

Last year a belt of 4-year-old trees saved many rows of potatoes from destruction by the wind. Forty-two rows yielded a bumper crop. Farther out the yield was medium, and the unprotected area beyond this was a total loss. Undoubtedly if these had been mature trees the whole field would have produced a good yield. The 4-year-old trees gave nearly perfect protection to about 130 feet and some protection to 200 feet beyond this.

This year a very-striking example of a tree-protected area is in evidence on Mr. Scott's farm. A barley field, protected only in part by the original belt mentioned, has a definite division running from the northwest to the southeast, the direction of the prevailing wind. The sheltered section is growing and is a healthy green, while the unprotected portion is stunted and sickly. This is directly traceable to the work of the wind.

Tree-Protected Areas Hold Moisture

Another fact Mr Scott has proven over and over again is the conservation of moisture on the tree-protected areas. He has one field of alfalfa protected by a shelterbelt, and

another one unprotected. Only about two-thirds the amount of water is used on the protected field, yielding a larger crop than on the unprotected field. Nearly any morning until 10 or 11 o'clock the protected alfalfa is still wet with the evening dew, while the unprotected field has been dried by the unhindered wind.

Mr. Scott's gardens and raspberry beds are all protected by trees. He does not try to start a new raspberry bed until he has the trees planted to protect it. This year his berries commanded a premium on the market because of their extra quality and size.

In 1934 Mr. Scott added another mile and a half of windbreaks, making a total of 2¼ miles on the 110 acres of crop land. Next year he hopes to complete his plans to surround each field with trees. He says that his work is not ended there as most of his trees are cottonwoods. Although this is a fast-growing tree, gives quick protection, and acts as a nurse tree to other species, he wants to gradually replace his original plantings with longer lived varieties such as elm, ash, hackberry, honey-locust, and Russian olive. These are not only longer lived but they require less moisture. He also has a good start of evergreens including red cedar, Ponderosa, and Austrian pine. "These will give me year-around protection and pay for the little extra care they require to get them started," said Mr. Scott. He states that the use of trees for shelterbelts is beyond the experimental stage with regard to wind erosion control on his farm.

Mr. Scott concludes: "Many fertile, irrigable fields now abandoned could be reclaimed in a few years with the aid of trees. What I have done can be done by any of my neighbors on this project, or any project with a little work and study. Before long this country, originally a treeless prairie, would be beautified by these plantings. But more than this, thousands of fertile irrigable acres will be reclaimed and built into profitable farms."

Any farmer in the western Great Plains area whose farm has soil that moves easily with the wind can with profit follow Mr. Scott's plan of farming with trees. Now is the opportune time to make the necessary arrangements for the trees you want to plant on your farm next spring.

UNITED STATES AREA IRRIGATED (Acres)

ARID IRRIGATION

	1889	1899	1902	1909	1919	1929	1936 [1]
Arizona	65,821	185,396	247,250	320,051	467,565	575,590	[2] 575,590
California	1,004,233	1,445,872	1,708,720	2,664,104	4,219,040	4,746,632	[2] 1,746,632
Colorado	890,735	1,611,271	1,754,761	2,792,032	3,348,385	3,393,619	3,360,162
Idaho	217,005	602,568	713,595	1,430,848	2,488,806	2,181,250	2,251,385
Kansas	20,818	23,620	28,922	37,479	47,312	71,290	[2] 71,290
Montana	350,582	951,154	1,140,694	1,679,084	1,681,729	1,594,912	[2] 1,594,912
Nebraska	11,744	148,538	245,910	255,950	442,690	532,617	710,000
Nevada	224,403	504,168	570,001	701,833	561,447	486,648	[2] 486,648
New Mexico	91,745	203,893	254,945	461,718	538,377	527,033	600,000
North Dakota	445	4,872	10,384	10,218	12,072	9,392	[2] 9,392
Oklahoma		2,759	3,328	4,388	2,969	1,573	[2] 1,573
Oregon	177,944	388,310	439,981	686,129	986,162	898,713	1,081,351
South Dakota	15,717	43,676	53,137	63,248	100,682	67,107	69,550
Texas	18,241	40,952	61,768	164,283	322,656	576,397	458,023
Utah	263,473	629,293	713,621	999,410	1,371,651	1,321,125	[2] 1,324,125
Washington	48,799	135,470	154,962	334,378	529,899	499,283	594,865
Wyoming	229,676	605,878	773,111	1,133,302	1,207,982	1,236,155	1,300,000
Total	3,631,381	7,527,690	8,875,090	13,738,485	18,329,421	18,722,336	19,235,498

RICE IRRIGATION (Exclusive of California)

	1889	1899	1902	1909	1919	1929	1936 [1]
Arkansas				27,753	143,946	151,787	128,000
Georgia		7,856	8,581				
Louisiana		201,685	387,580	380,200	454,882	450,901	535,000
North Carolina		3,283	3,422				
South Carolina		29,690	38,220				
Texas	(9,450)	8,700	168,396	286,847	263,464	222,520	110,500
Total rice		251,214	606,199	694,800	862,292	825,208	773,500

HUMID IRRIGATION

	1889	1899	1902	1909	1919	1929	1936 [1]
Alabama		89	95				
Connecticut		471	379				355
Delaware							10
Florida		1,538	3,772				63,000
Illinois							630
Indiana							550
Iowa							1,000
Maine		17	17				98
Maryland							1,150
Massachusetts		134	283				2,000
Michigan							7,600
Minnesota							895
Mississippi		40	114				
New Jersey		73	48				6,000
New York		68	159				1,825
Ohio							10,000
Pennsylvania		814	906				300
Rhode Island		40	15				200
Vermont							7
Virginia							3,600
Wisconsin							310
Total, humid		3,284	5,788				99,560
Grand total	3,631,381	7,782,188	9,487,077	14,433,285	19,191,716	19,547,544	20,108,558
Federal Reclamation projects				410,628	1,187,255	1,483,900	1,702,192

California rice, included in arid irrigation, 1912, 1,400 acres, 1919, 155,000 acres; 1929, 95,000 acres, 1936, 140,000 acres

1889. Data in Thirteenth Census, 1910 Abstract Volume, table 3, p. 423, and also in volume of Eleventh Census, 1890, entitled, Agriculture by Irrigation, F. H. Newell.

1899 and 1902. Bulletin No. 16, Bureau of Census, 1904, by C. J. Blanchard. Table 5, p. 11; table 9, p. 16; table 10, p. 17.

1909. Data in Fourteenth Census of U. S. vol., 7. Irrigation and Drainage, table 1, p. 15. Rice irrigation is given in table 21, p. 432, Abstract Census, 1910.

1919. Data Fifteenth Census of U. S.—Irrigation of Agricultural Lands, p. 15. Rice in Texas considered as area "Other tributaries of Gulf of Mexico," table 7, p. 215.

1929. Data Fifteenth Census of U. S. on Irrigation, 1930, Irrigation of Agricultural Lands, p. 15. Rice in Texas, considered as area "Other tributaries of Gulf of Mexico," p. 215.

1936. Humid irrigation from C. R. E. A. Bull entitled Electric Power for Irrigation in Humid Regions, vol. 7, No. 2, July 1937, p. 3.

[1] If not 1936, latest figures available.
[2] 1929, later figures not available.

New Price List

A New Price (List, No. 11, superseding previous lists) has just been issued and is now available for distribution, free of charge, on application.

It is a pamphlet of 34 pages, with map of projects, containing a list of the handbooks, specifications, maps, standard and special designs of irrigation structures, experimental data cards, town site and farm unit plats, and other publications for sale.

Information is also given in regard to the revised edition of the Dams and Control Works soon to be available in Washington office and of the Technical Memoranda for sale in the office of the Chief Engineer in Denver, Colo.

Lists of the engineering reports, pamphlets, and educational material and project circulars available for free distribution are included. A list is also given of the motion-picture films available for loans to educational organizations, and prices of photographs available.

Mesa County Retires Bonds

Of special interest to the Bureau of Reclamation and particularly to the fruit growers in the upper valley was the retirement, during November, of the remaining outstanding bonds of the Mesa County Irrigation District, Grand Valley project, amounting to approximately $10,000. This district has likewise settled all outstanding water rental charges due the United States, which are payable in semiannual installments.

Work of the Civilian Conservation Corps at Elephant Butte Reservoir

By L. R. FIOCK, *Superintendent, Rio Grande Reclamation Project and Regional Director, CCC*

INCIDENTAL to the purpose for which they were constructed and the function which they serve to irrigation projects, many of the reservoirs of the Bureau of Reclamation afford recreational opportunities not otherwise provided by nature in the territory in which they are located. This is particularly true of those reservoirs built in the arid Southwest. As peculiar as it may seem, however, the more these artificial bodies of water contrast with their natural geographical and climatological surroundings, the more development or improvement work there is required to take full advantage of those opportunities.

In the vicinity of Elephant Butte Dam, built in New Mexico to create a reservoir of irrigation water serving the Rio Grande Reclamation project, a three-phase work program especially suited to the purpose and activities of the Civilian Conservation Corps is well under way. Work in the vicinity of the dam left incomplete and finishing touches left off at the close of the construction period are being accomplished. Improvements, replacements, and extensions to facilities and utilities required in connection with the operation of the dam, camp, and recreational area have been made. Development of recreation features and providing facilities therefor, including the construction of concession and service buildings and a fish hatchery are in progress with considerable work already done on these.

Terracing and steps to boat landing constructed by CCC at Elephant Butte Reservoir.

C. C. C. Camps and Facilities

With C. C. C. Camp BR-54 assigned to the work since October 1934 and Camp BR-8 since October 1936, a great deal of very fine work has already been accomplished, constituting not only permanent improvement of the irrigation project but affording recreational facilities for the community, to be enjoyed by the public generally; and all of such a nature as to be a tribute and a lasting credit to the Civilian Conservation Corps.

When preparations were being made in 1910–11 for the construction of Elephant Butte Dam a group of buildings of permanent type of construction was provided as the government headquarters, one mile east of the dam. The group consists of 14 residences, a two-story hotel building, an office building now being used as a concession building, mess hall, testing laboratory, and hospital now being used for apartments. It is around this group of buildings, with the availability of such utilities as electricity, water and sewer systems, and roads, that the recreational area is being developed. For the first C. C. C. company assigned to Elephant Butte the availability of these utilities and buildings provided a convenient and economic set-up. The hotel provides, in one building, the company headquarters, recreational hall, reading room, canteen, class rooms, storerooms, and officers' and technicians' quarters. The old mess hall is serving as the company mess and the testing laboratory as the infirmary. The families of the company officers and supervising personnel are able to live near camp in the residence cottages. For this company it was necessary to construct only the barracks group of buildings. Because of this economy it was possible to obtain the construction of 21 cabin-type barracks to accommodate six C. C. C. enrollees each, in place of two of the usual four or five 50-men barracks. This was done in anticipation of their availability for overnight cabins for tourists at the termination of the camp. For that purpose they will, of course, be moved to suitably located and prepared sites.

The terrain in the vicinity of Elephant Butte Dam is very hilly, steep, rocky, and generally devoid of soil. All service areas and building sites require terracing and filling in. Every bit of excavation for terracing and landscaping, road construction and trenching for pipe lines requires drilling and blasting. Soil for all

planting and tree holes must be hauled in over considerable distance. The shore line terrace, about a mile in length, which is being developed into a service and recreational area, was the railroad grade and quarry pits during the dam construction period. The total area of this terrace is about 7 acres and the excavation of 30,000 cubic yards of rock and placing of 15,000 cubic yards of earth fill with 3,000 square yards of rock riprap to protect the facing was involved in the raising of its level 2 to 14 feet to escape the high water level of the reservoir.

Summing up briefly the C. C. C. accomplishments to date, the work done at Elephant Butte may be reviewed as follows: The former winding and narrow mountain roads on the reserve in the vicinity of the dam, the headquarters and the recreational area have been improved, widened, and in some instances relocated, involving about 4 miles of heavy rock construction. A completely new electric transmission and distribution system has been provided and the 150-kilowatt hydroelectric plant serving the area was converted to automatic operation to give 24-hour service with the employment of one operator; a new 6-inch cast-iron water main was laid from the storage tank to the area with new distribution system, including an extensive sprinkler irrigation system to provide irrigation for the planting groups; a new sewer system and disposal plant has been installed.

An extensive amount of terracing, landscaping, and planting has been accomplished. The limited area available for camp grounds has been intensively developed to provide as many units as possible. Each unit is equipped with fireplace, table and bench combination and electric light, with a convenience receptacle mounted on a post, for plugging in electric appliances or a trailer. A very commodious comfort station and dressing room has been provided. Storage yards and sheds for use in the permanent operations of the Government, as well as for the duration of C. C. C. activities, have been built.

Building Program

With the sites prepared and the utilities now provided, a building program has been launched for Camp BR 54 which will provide the public with the facilities to take advantage of the work already completed and to enjoy the recreational opportunities at Elephant Butte Reservoir. A large combination and concession building of Spanish colonial architecture, to include men's and women's dressing rooms, store, restaurant, confectionery, pavilion or lounge room and attendants' quarters, also a portal and a roof terrace or balcony. This rambling building is located at one side of the service, or parking, area at the head of a combination stone stairway and trail which has been built down to the boat docks and diving platforms for swimmers.

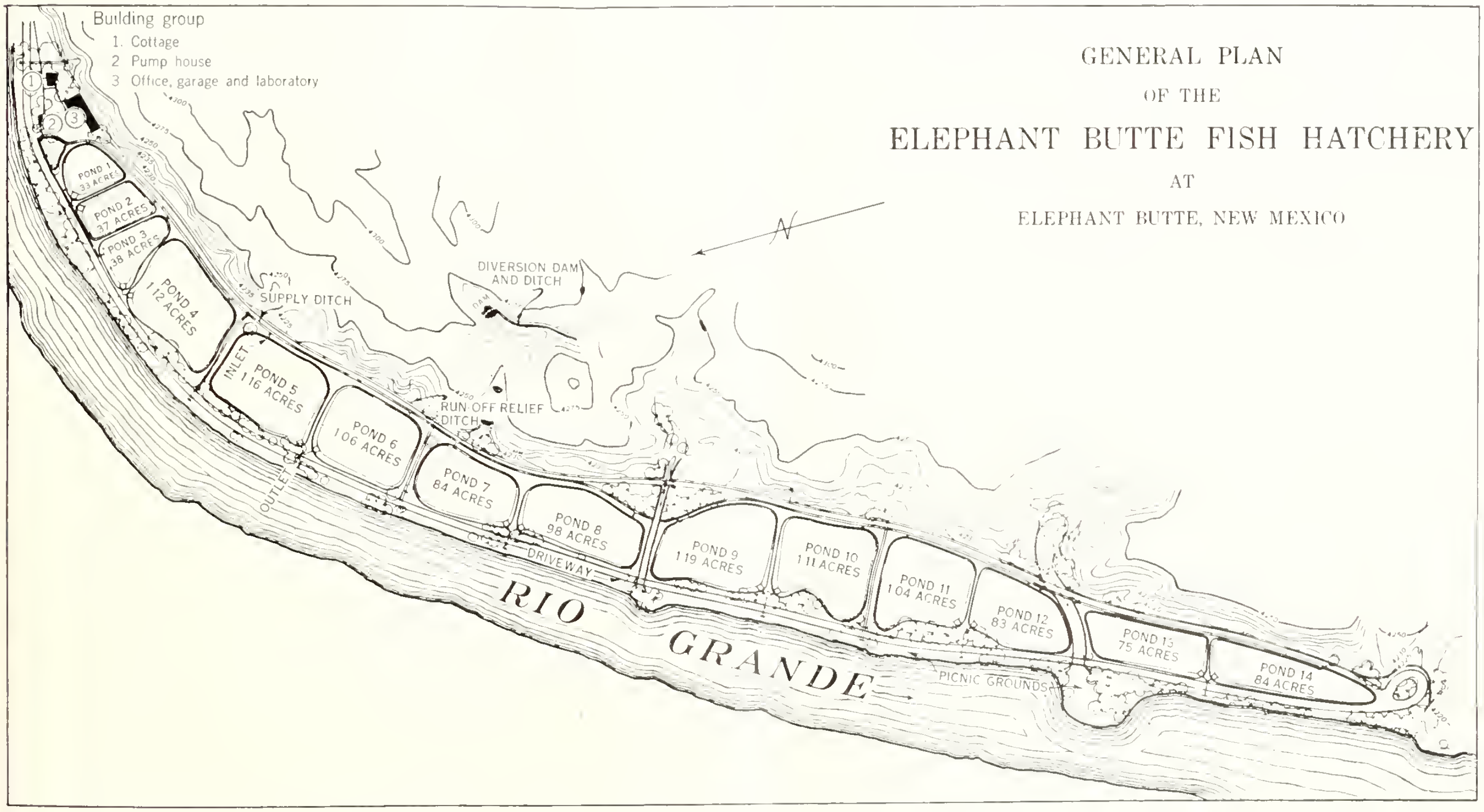
At the opposite side of the parking area work has been started on a connected group of service buildings consisting of a boat repair shop, gasoline and oil service station, and a locker room to afford individual lockers for boat owners to store their motors, and boating accessories and fishing tackle. To lead down to the boat servicing docks from the boat shop there has already been built an inclined tramway of steel rails and concrete to launch boats and for lowering motors and accessories.

The edge of the terrace in the vicinity of the concession building and docks is being finished off to form a stadium for seating of spectators during regatta celebrations and of other water sports. Beyond the concession building, the terrace will terminate in a wading pool for children, as the deep water in the reservoir and the absence of beaches in the immediate vicinity can offer inducement only to expert swimmers.

In the immediate vicinity of the dam a general clean-up of debris and refuse, with removal of all unnecessary telephone and electric poles and wiring, has been accomplished, terracing and necessary masonry retaining walls, ditching for improving drainage conditions, trail building, and the construction of public comfort stations is in progress. Excavation of the spillway channel, left unexcavated when the spillway chute was originally constructed, was a job of major proportions involving a large amount of rock excavation.

Fish Hatchery

A feature which is of general community interest and especially sponsored by game associations is the construction of a fish hatchery. Having been in the promotional development stage for nearly 3 years with the necessary arrangements having been made between all parties concerned, and there



being an indication that the Civilian Conservation Corps would be continued for a sufficient time to complete such an undertaking, construction was actually begun on October 1, 1937 as a major item in the work program of Camp BR-8.

An interdepartmental agreement between the Department of the Interior and the Department of Commerce provides for the hatchery to be built on the reservoir reserve land by the Bureau of Reclamation C. C. C. camps, and when completed to be turned over to the Bureau of Fisheries for operation. The Bureau of Fisheries designates a technician to direct the construction in accordance with the plans as approved by that Bureau. Construction is to include a building for the operating foreman, necessary storage and service facilities, and installation of pumping equipment, etc. Electricity for pumping the water supply for the hatchery ponds is to be supplied from the hydro-electric plant at Elephant Butte Dam.

The site of the hatchery is a bench three-quarters of a mile in length along the east bank of the Rio Grande beginning about three-quarters of a mile below Elephant Butte Dam. During the construction period for the dam, this fish hatchery site was the construction town. The hatchery will consist of eleven ponds of approximately one acre each and three smaller ones.

Because of the limited area available, the hatchery is being constructed for intensive operation and propagation. All ponds will be on the same level. The water level will be automatically regulated by a float-switch control of the pumps at the head of the supply ditch connecting with all ponds. The ponds are at sufficient elevation to drain out through the kettle structures by gravity to the river.

The hatchery will be of the type adapted to the propagation of warm-water fish. Black bass will be the principal specie produced. The capacity is expected to be 250,000 to 500,000 depending on the size to which the young fish are carried in the ponds. The output is to be used for stocking Elephant Butte Reservoir, Caballo Reservoir a short distance below, and the river and drainage ditches of the Rio Grande project. Because of the rising or falling water surface in the reservoir, which usually occurs at the normal spawning season, propagating conditions in the reservoir itself are not very favorable; hence the desire and need for a hatchery from which to consistently stock it. It is expected that some of the ponds will be ready for use during the next season.

The road leading from the east end of the dam to the hatchery site has been improved. A driveway will be provided along the river bank for the length of the hatchery. Landscaping and picnic grounds will be developed where there is available space, but camping in the hatchery area will not be permitted. As may be inferred, the construction of the hatchery and related features involves quite a variety of work for the C. C. C. enrollees.

Site of fish hatchery being built by CCC on Rio Grande below Elephant Butte Reservoir.

Transfer of Construction Engineers

ASSIGNMENT of engineers to bring to completion two large reclamation dam projects in the West has been announced by Secretary of the Interior Harold L. Ickes. The action involves the transfer of Ernest A. Moritz, construction engineer at Parker Dam, Calif., to the same position at the Marshall Ford Dam of the Colorado River project near Austin, Tex., and of Howard P. Bunger, construction engineer now at the Marshall Ford Dam, to take Mr. Moritz's place at the Parker Dam.

The reassignment of the two engineers was recommended by Commissioner of Reclamation John C. Page to put engineers of qualified training on work in which they have become skilled. Mr. Moritz, who has had wide experience in the construction of concrete dams, will take over duties at Marshall Ford Dam where pouring of concrete has just started. He will supervise the work through its completion.

Mr. Bunger will take over the task of installing gates at the Parker Dam project. Most of the concrete work was finished at this project under the direction of Mr. Moritz, and Mr. Bunger will bring the dam to completion.

Parker Dam is one of the larger dams in the West. It will serve as part of the Metropolitan Water District of the Southern California project, and will impound water to be taken to Los Angeles and surrounding towns by an immense pipe line. This concrete arch dam, will have a maximum over-all height of 388 feet and will be 800 feet long.

The Marshall Ford Dam is located 12 miles northwest of Austin, Tex. The reservoir to be formed by the dam will be used jointly for flood control, power, and regulation to augment the low water flow for irrigation purposes along the Colorado River below Austin. It is part of the general Colorado River project.

Mr. Moritz was born in Sheboygan, Wis., and received engineering degrees at the University of Wisconsin in 1904 and 1905. He served for a number of years in engineering posts for railroads before joining the Bureau of Reclamation. During his service with the Bureau, he worked on the Yakima project in Washington, on the Flathead project in Montana, and in the Bureau offices at Washington, D. C., and Denver.

Mr. Bunger was born at Wheat Ridge, Colo., and received his degree in engineering at the University of Colorado in 1914. He served with the Santa Fe Railroad and spent a number of years in Mexico on engineering and reclamation assignments. From 1920 to 1926 he was in the Bureau of Reclamation office in Denver and has been at the Marshall Ford Reservoir job since July 1935.

Karakul Sheep

A recent shipment of Karakul lambs from the Minidoka project to South America has focused attention on the Karakul-sheep industry, which is becoming of increasing importance on the project. A unit of the United Karakul Fur Sheep Co. has been formed, representing 30 breeders and others interested, to promote the growth and marketing of this breed of sheep.

Progress of Investigations of Projects

Kings River-Pine Flat project, California.—The engineer in charge has arrived on the project to initiate these investigations.

Blue River transmountain, Colorado.—Levels were run along the canal line from Waterton to Watkins, Colo., and topography was taken at the reservoir site on Tollgate Creek. Capacities of the Leal and Waterton reservoir sites were computed. A geological examination was made of the Mill Gulch dam site on the South Platte River and along two tunnel sites from Mill Gulch through the hogback to the east. Studies are being made to determine the most economical system of regulatory storage on the Eastern Slope. A map was prepared showing mining properties in reservoir sites on Clear Creek at Fall River and Empire, and the general map of the project is in progress. Preparation of report on the water supply features is in progress.

Colorado-Big Thompson transmountain diversion, Colorado.—Work was continued on the report covering transmission line location over Buchanan or Rawlins Pass. A preliminary estimate was completed for the two power plants proposed for installation at the Green Mountain dam site. The operation study of Green Mountain Reservoir was under revision.

Eastern Slope surveys, Colorado.—Topographic surveys were under way on the Smoky Hill River project. Studies were made to determine the water supply available for the projects under consideration on the Eastern Slope. The flood control study on Cherry Creek was continued. Reports on Cherry Creek, Trinidad, and North Republican River projects are in progress.

Western Slope Surveys, Colorado—(a) *Collbran project.*—Test pits were completed and percolation tests were made on the pits at the Meadow dam site.

(b) *Florida project.*—Detail topography and an axis profile were taken on the Miller Creek dam site. Exploration of the foundation conditions was begun.

(c) *La Plata project.*—An investigation was made of the altitude-run-off relationships in the project area, and a study was begun of the available storable waters.

(d) *Paonia project.*—Cross-sections of the Fire Mountain Canal were completed.

(e) *Piceance project.*—Test pits and auger holes were completed and mapped. Percolation tests were made on the pits.

(f) *Silt project.*—Estimates were made for the construction of a ditch from Corral Creek to West Elk Creek.

(g) *Troublesome project.*—Diamond drilling and test pits were completed at the Rabbit Ear dam site.

(h) *West Divide project.*—Water supply studies for the project were completed.

Boise (Boise-Weiser-Payette), Idaho—(a) *Twin Springs dam site.*—The original topography at this site was extended upstream. A report on the geology of the site was prepared.

(b) *Gold Fork dam site.*—The planetable sheets were completed and a geologic reconnaissance was made.

(c) *Garden Valley dam site No. 3.*—The planetable sheets were completed and a further geologic study of the site was made.

(d) *Tamarack dam site.*—The planetable sheet of this site was completed and foundation testing begun. The survey of the canal line was completed and plotting of the line was begun.

(e) *Lost Valley reservoir.*—The planetable sheet covering the dam at this site was completed.

(f) *Weiser River reservoir sites.*—Further reconnaissance was made of the watershed to locate possible reservoir sites and geological examination was made of one of the sites.

(g) *Cascade reservoir site.*—Topographic and land classification surveys were in progress.

(h) *Cabarton dam site.*—Preliminary designs and estimates for two different heights of dams were begun.

(i) *Upper Payette Lake reservoir site.*—The highway relocation survey was completed.

(j) *Garden Valley-Brainard Creek Tunnel.*—A field examination was made of the geologic conditions along the line of this proposed tunnel.

(k) *Indian Creek Feeder to Deer Flat Reservoir.*—A reconnaissance survey of the feeder canal was made.

(l) *Weiser water supply study.*—Water supply studies were continued.

Snake River Storage—South Fork, Idaho.—Field work on the planetable sheets of the topography of the Narrows dam site was completed.

Gallatin Valley investigations, Montana.—The report on these investigations was ready for distribution.

Madison River diversion, Montana.—A preliminary water supply study was made.

Buford Trenton investigations, North Dakota.—Topographic surveys were continued on the Trenton flat.

Altus project surveys, Oklahoma.—A study of the storm rainfall frequency over the area of the North Fork of the Red River above the dam site was made.

Kenton project, Oklahoma.—Land classification was carried on, check levels were run, tentative dam sites were selected, and studies were initiated on the watershed of the Cimarron River to classify the soils and topography.

Canby project investigations, Oregon.—Water supply studies and work on the report on these investigations were continued.

Grande Ronde investigations, Oregon.—Topographic survey and land classification of the valley were completed. The Sanderson Springs Reservoir site was surveyed, and a survey was carried on for relocating the railroad around the Lower Grande Ronde Reservoir site. Diamond drilling was completed at the Catherine Creek Reservoir site.

Black Hills investigations, South Dakota.—A study was made of the storm rainfall frequency on the Rapid Creek basin and flood studies for the Rapid Valley project were continued.

Utah investigations.—Water supply studies were begun on the Blue Bench investigations; the report of the Dixie project was completed, and under the Gooseberry investigations a reconnaissance was made of the possibility of diverting water from the Scofield Reservoir.

Utah-Idaho-Wyoming investigations—Green River-Bear River surveys.—The field work was completed on the canal line from the Green River to the Bear River and the report is being prepared.

Colorado River Basin investigations—(a) *Gunnison River area, Colorado.*—Classification of the undeveloped areas was completed.

(b) *White River, Colorado.*—Classification of the undeveloped lands was continued. The mapping of irrigated lands was continued and horizontal control extended.

(c) *Lower White River project, Colorado.*—Placing of horizontal control was begun, and classification of part of the area was completed.

(d) *Fremont, Escalante, and Paria Rivers, Utah.*—Horizontal control for the classification of irrigated lands in the Fremont drainage was carried on, and classification of lands adjacent to the present irrigated areas was completed in the drainage areas of the Fremont, Escalante, and Paria Rivers.

Repayment Commission in Denver

THE Repayment Commission will hold its final sessions in Denver beginning January 20, when the report of its findings will be prepared and submitted to the Secretary of the Interior.

Miss Gladys L. Whitney of the engineering division, Washington office, Miss Katherine F. Tully of the commissioner's office, and Mr. Everett K. Gould of the Denver office, accompanied the committee over the various projects visited and, under the direction of George O. Sanford, chief of operation and maintenance, rendered valuable assistance in reporting the several hearings.

As noted in the December (1937) issue of the Era the members composing the commission are:

Dr. Charles A. Lory, chairman.
William R. Wallace.
George T. Cochran.
Goodrich W. Lineweaver, executive secretary.

Reclamation Organization Activities and Project Visitors

Commissioner Page Returns to Washington

JOHN C. PAGE, Commissioner of Reclamation, returned to Washington on December 22 after a 3-weeks' western tour, his itinerary including the Columbia Basin project, Washington, and the Boulder Canyon project, Arizona-Nevada. Mr. Page was accompanied on his trip by his secretary, Miss Mary E. Gallagher.

Appointments

The following appointments were recently authorized by the Secretary of the Interior:

Denver Office:

Gordon H. Johnson, junior engineer, Eastern Slope Surveys.

Frank Tessitor, junior enigneer, vice Frank J. Van Horn, resigned.

Central Valley (Friant division):

David S. Stoner, assistant engineer.

Columbia Basin:

Arthur R. Chase, assistant Reclamation Economist.

Transfers

The following transfers were recently authorized by the Secretary of the Interior:

To Denver Office:

Cleves H. Howell, Jr., junior engineer from Pagosa Springs, Colo.

William J. Colson, Jr., assistant engineer, from Hydraulic Laboratory, Fort Collins, Colo.

Paul B. Ritterspach, junior engineer, Colorado-Big Thompson and Blue River Survey, from engineering draftsman, Colorado River Investigations, also at Denver.

To Colorado River project:

Donald G. Kretsinger, assistant engineer, from junior engineer, Denver, Colo.

To Central Valley project (Antioch):

John K. Ayers, junior engineer, from Denver, Colo.

To Buffalo Rapids project:

Parley R. Neeley, associate engineer, from Ogden River.

To Utah projects, Salt Lake City:

Elton G. Knight, associate engineer, from Milk River, Havre, Mont.

To Kings River, Pine Flat Irrigation and Flood Control Secondary Project, Fresno, Calif.:

John R. Iakisch, construction engineer, from Ogden River project, Ogden, Utah.

Resignations

The following resignations have recently been accepted by the Secretary of the Interior:

Denver:

Daniel G. O'Shea, associate engineer, to accept employment with Washington State Highway Department at Seattle.

Ralph G. Tuttle, Walter F. Koller, Arthur E. W. Dodds, and Jacob J. Altman, junior engineers, to go with the Washington State Highway Department, Olympia, Wash.

James A. Larsen, Jr., junior engineer, to enter private industry in Chicago, Ill.

Maurice C. Lipp, assistant engineer, to accept offer of employment with the Portland Cement Association at Chicago, Ill.

Reclamation Babies

William E. Warne, Director of Information in the Washington office, is receiving congratulations on the birth of a son born on November 30. The youngster will be named William Robert. This is the second child born to Mr. and Mrs. Warne. The first, a girl, Jane, is now 3 years old.

Mrs. Frances H. Jackson, senior stenographer in the Washington office, is the proud mother of a son, William Lewis, born in Washington on December 6. Mrs. Jackson's first child, Mary Patricia, is now 5 years old.

Mrs. Thomas H. Wigglesworth, wife of Mr. Wigglesworth, assistant engineer in the Washington office, presented her husband with a son, Thomas Hudson, Jr., on October 23. Elizabeth Bosworth, their little daughter, is now 2 years old.

Robert Charles Mann, son of Mr. and Mrs. Charles Mann, was born on August 2. Mr. Mann is a junior clerk in the Engineering division of the Washington office.

Doris Rocker, daughter of Mr. and Mrs. Harold E. Rocker, was born in Washington on September 10. The father is a valued clerk in the Mails and Files division of the Washington office.

A baby daughter, Joan, was born to Mr. and Mrs. Charles F. Winter on September 5. Joan has two brothers, Eric and Page. Mr. Winter is employed in the Accounts Division of the Washington office.

Bass in Lake Mead

Between 75,000 and 100,000 bass, ranging in size from fingerlings to husky 5-pound beauties, were planted in Lake Mead, Boulder Canyon project, during November.

OWYHEE *Public Land Opening*

SECRETARY ICKES has announced the opening to entry on January 31, 1938, of 51 public land farm units on the Succor Creek division, the units ranging in size from 11 to 106 irrigable acres, located in both Oregon and Idaho. For a period of 90 days, or until April 30, 1938, these units will be open to entry only by officers, soldiers, sailors, or marines who have served in the Army or Navy of the United States in any war, military occupation, or military expedition, and have been separated or discharged therefrom or placed in the Regular Army or Naval Reserve. Any units that may remain unentered after the 90-day period, on or after May 2, 1938, will be available to other duly qualified citizens of the United States.

Each applicant must possess good health and vigor and have had at least 2 years' actual experience in farm work and farm practice. He must have at least $2,000 in money, free of liability, or the equivalent thereof in livestock, farming equipment or other assets deemed by the examining board to be as useful to the applicant as money. Provided, however, that for farm units having irrigable areas of not more than 20 acres the applicant must have a net worth of $1,000 or the equivalent thereof.

Copies of the public notice, farm application blank, and descriptive matter may be obtained by addressing the Commissioner, Bureau of Reclamation, Washington, D. C., or the Construction Engineer, Owyhee Project, Boise, Idaho.

• TECHNICAL MEMORANDA •

THE Bureau of Reclamation has issued more than 560 Technical Memoranda on all phases of the engineering investigations in connection with the construction of the immense dams and irrigation works.

In view of the many requests for these publications, a limited number of which have been issued in mimeographed form, a price list has been compiled, as also a list of authors, and a subject index. The subject index was completed recently by R. E. Kennedy and includes subjects ranging from "Airy's Function" to "X-Ray."

Application for these Technical Memoranda should be made to the office of the Chief Engineer, Bureau of Reclamation, Denver, Colo., and should be accompanied by check or money order drawn to the Bureau of Reclamation. The price list is obtainable, without charge, from the Chief Engineer.

Municipal Building in Rupert

The city of Rupert, Idaho (Minidoka project), has sold an issue of $30,000 of municipal bonds to be used in the erection of a municipal building in Rupert. It is expected that the building will cost about $65,000, the balance of the funds to be obtained from the P. W. A.

U. S. GOVERNMENT PRINTING OFFICE: 1938

ADMINISTRATIVE ORGANIZATION OF THE BUREAU OF RECLAMATION

HAROLD L. ICKES, SECRETARY OF THE INTERIOR

———, FIRST ASSISTANT SECRETARY, in charge of reclamation

John C. Page, Commissioner — **Roy B. Williams**, Assistant Commissioner

J. Kennard Cheadle, Chief Counsel and Assistant to Commissioner; Miss Mae A. Schnurr, Chief, Division of Public Relations; George O. Sanford, General Supervisor of Operation and Maintenance; D. S. Stuver, Asst. Gen. Supr ; Wesley R. Nelson, Chief, Engineering Division; P. I. Taylor: Assistant Chief; A. R. Golzé, Supervising Engineer, C. C. C. Division; William F. Kubach, Chief Accountant; Charles N. McCulloch, Chief Clerk; Jesse W. Myer, Chief, Mails and Files Division; Miss Mary E. Gallagher, Secretary to the Commissioner

Denver, Colo., United States Customhouse

R F. Walter, Chief Eng.; S. O. Harper, Asst. Chief Eng.; J. L. Savage, Chief Designing Eng.; W. H. Nalder, Asst. Chief Designing Eng.; L. N. McClellan, Chief Electrical Eng.; Kenneth B. Keener, Senior Engineer, Dams; H. R. McBirney, Senior Engineer, Canals; E. B. Debler, Hydraulic Eng.; I. E. Houk, Senior Engineer, Technical Studies; Spencer L. Baird, District Counsel; L. R. Smith, Chief Clerk; Harry Caden, Fiscal Agent; A. McD. Brooks, Purchasing Agent; C. A. Lyman and Henry W. Johnson, Field Representatives; L. S. Davis, Engineer. C. C. C. Division

Projects under construction or operated in whole or in part by the Bureau of Reclamation

Project	Office	Official in charge		Chief clerk	District counsel	
		Name	Title		Name	Address
All-American Canal[1]	Yuma, Ariz.	Leo J. Foster	Constr engr	J C. Thrailkill	R. J Coffey	Los Angeles, Calif.
Belle Fourche	Newell, S. Dak.	F. C. Youngblutt	Superintendent	J. P. Siebeneicher	W. J. Burke	Billings, Mont.
Boise	Boise, Idaho	R J. Newell	Constr. engr	Robert B. Smith	B. E. Stoutemyer	Portland, Oreg.
Boulder Dam and power plant[1]	Boulder City, Nev.	Ralph Lowry	do	Gail H. Baird	R. J Coffey	Los Angeles, Calif
Buffalo Rapids	Glendive, Mont.	Paul A. Jones	do	Edwin M. Bean	W. J Burke	Billings, Mont.
Burnt River	Unity, Oreg.	Clyde H. Spencer	do		B. E. Stoutemyer	Portland, Oreg.
Carlsbad	Carlsbad, N. Mex.	L E. Foster	Superintendent	E. W. Shepard	H J S Devries	El Paso, Tex
Alamogordo Dam	Fort Sumner, N Mex.	Wilfred W Baker	Constr engr		do	Do
Central Valley	Sacramento, Calif.	W R. Young	do	E. R. Mills	R. J Coffey	Los Angeles, Calif.
Colorado-Big Thompson	Denver, Colo.	Mills E. Bunger	Engineer			
Colorado River	Austin, Tex.	Ernest A. Moritz	do	William F. Sha	H. J S. Devries	El Paso, Tex
Columbia Basin	Coulee Dam, Wash.	F. A Banks	do	C. B. Funk	B. E Stoutemyer	Portland, Oreg.
Gila	Yuma, Ariz.	Leo J. Foster	Constr. engr		R. J. Coffey	Los Angeles Calif
Grand Valley	Grand Junction, Colo.	W J Chiesman	Superintendent	Emil T Ficenec	J R Alexander	Salt Lake City, Utah
Humboldt	Lovelock, Nev.	Stanley R. Marean	Resident engr.[2]	George B. Snow	do	Do.
Kendrick	Casper Wyo.	H W. Bashore	Constr. engr	C M Voyen	W. J Burke	Billings, Mont.
Klamath	Klamath Falls, Oreg.	B E. Hayden	Superintendent	W. I Tingley	B E Stoutemyer	Portland, Oreg.
Milk River	Malta, Mont.	H. H Johnson	do	E E Chabot	W J Burke	Billings, Mont
Fresno Dam	Havre, Mont.	H. V. Hubbell	Constr engr	do	do	Do.
Minidoka	Burley, Idaho	Dana Templin	Superintendent	G. C Patterson	B E Stoutemyer	Portland, Oreg.
Moon Lake	Duchesne, Utah	E J. Westerhouse	Constr. engr	Francis J Farrell	J. R Alexander	Salt Lake City, Utah.
North Platte	Guernsey, Wyo.	C F Gleason	Supt. of power	A T Stumpfig	W J Burke	Billings, Mont
Orland	Orland Calif.	D. L Carmody	Superintendent	W. D Funk	R J. Coffey	Los Angeles, Calif.
Owyhee	Boise, Idaho	R J. Newell	Constr engr	Robert B Smith	B E. Stoutemyer	Portland Oreg.
Parker Dam	Parker Dam, Calif.	Howard P. Bunger	do	George W Lyle	R J. Coffey	Los Angeles, Calif
Pine River	Durango, Colo	Charles A Burns	do	John S. Martin	J. R. Alexander	Salt Lake City, Utah.
Provo River	Salt Lake City, Utah	E O Larson	Engineer	Francis J Farrell	do	Do.
Rio Grande	El Paso, Tex.	L. R Fiock	Superintendent	H. H Berryhill	H. J S Devries	El Paso, Tex.
Caballo Dam	Caballo, N Mex.	S F Crecelius	Constr engr	do	do	Do
Riverton	Riverton, Wyo	H D. Comstock	Superintendent	C. B. Wentzel	W. J Burke	Billings, Mont.
Bull Lake Dam	do	Arthur P. Smyth	Resident engr		do	Do
Salt River	Phoenix, Ariz.	E. C Koppen	Constr engr	Edgar A Peek	R J. Coffey	Los Angeles, Calif
Sanpete	Salt Lake City, Utah	E. O Larson	Engineer	Francis J Farrell	J R Alexander	Salt Lake City, Utah
Shoshone	Powell, Wyo.	L. J Windle	Superintendent[2]	L. J. Windle[2]	W J Burke	Billings, Mont
Heart Mountain	Cody, Wyo.	Walter F Kemp	Constr engr	do	do	Do
Sun River, Greenfields division	Fairfield, Mont.	A W. Walker	Superintendent		do	Do
Truckee River Storage	Reno, Nev.	Charles S. Hale	Constr engr	George B Snow	J R Alexander	Salt Lake City, Utah
Umatilla (McKay Dam)	Pendleton, Oreg.	C L Tice	Reservoir supt		B E. Stoutemyer	Portland Oreg.
Uncompahgre (Repairs to canals)	Montrose, Colo.	C B. Elliott	Constr engr	Ewalt P Anderson	J R. Alexander	Salt Lake City, Utah.
Upper Snake River Storage[3]	Ashton, Idaho	H A Parker	do	Emmanuel V Hillius	B E Stoutemyer	Portland, Oreg.
Vale	Vale, Oreg.	C C. Ketchum	Superintendent		do	Do
Yakima	Yakima, Wash.	J S Moore	do	Philo M Wheeler	do	Do
Roza division	do	Charles E Crownover	Constr engr	Alex S Harker	do	Do
Yuma	Yuma, Ariz.	R C. E Weber	Superintendent	Noble O Anderson	R J Coffey	Los Angeles, Calif

[1] Boulder Canyon [2] Acting [3] Island Park and Grassy Lake Dams.

Projects or divisions of projects of Bureau of Reclamation operated by water users

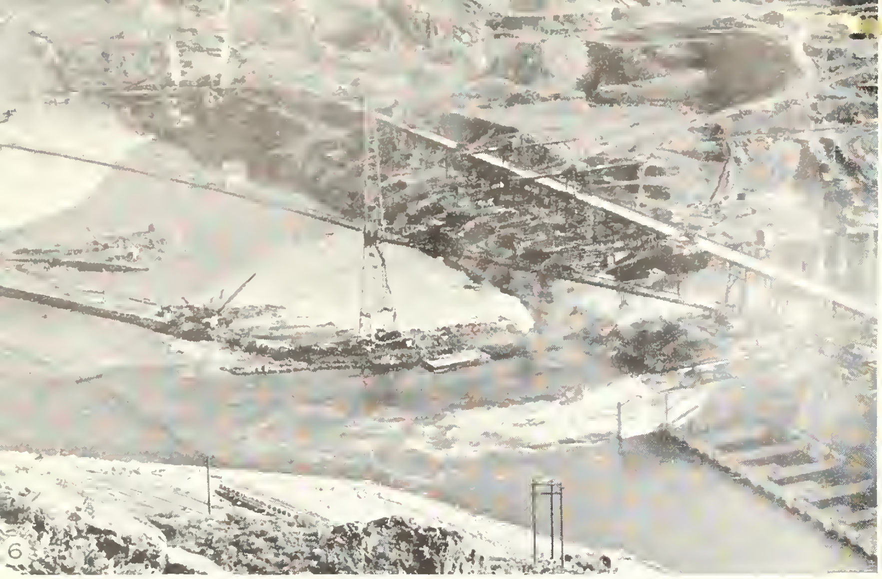
Project	Organization	Office	Operating official		Secretary	
			Name	Title	Name	Address
Baker (Thief Valley division)[1]	Lower Powder River irrigation district	Baker, Oreg.	A. J. Ritter	President	F. A. Phillips	Keating
Bitter Root[4]	Bitter Root irrigation district	Hamilton Mont	N. W Blindauer	Manager	Elsie H. Wagner	Hamilton.
Boise[1]	Board of Control	Boise, Idaho	Wm. H Tuller	Project manager	F J Hanagan	Boise.
Do.	Black Canyon irrigation district	Notus, Idaho	W. H. Jordan	Superintendent	L M Watson	Caldwell.
Frenchtown	Frenchtown irrigation district	Frenchtown, Mont			Ralph P. Scheffer	Huson
Grand Valley, Orchard Mesa[3]	Orchard Mesa irrigation district	Grand Jctn Colo	C. W. Tharp	Superintendent	C. J. McCormich	Grand Jctn
Huntley[4]	Huntley irrigation district	Ballantine, Mont	E E. Lewis	Manager	H. S. Elliott	Ballantine
Hyrum[3]	South Cache W. U. A	Hyrum, Utah	B L. Mendenhall	Superintendent	Harry C Parker	Logan.
Klamath, Langell Valley[1]	Langell Valley irrigation district	Bonanza, Oreg.	Chas. A. Revell	Manager	Chas A Revell	Bonanza.
Klamath, Horsefly[1]	Horsefly irrigation district	do	Henry Schmor, Jr	President	Dorothy Eyers	Do.
Lower Yellowstone[4]	Board of Control	Sidney, Mont	Axel Persson	Manager	Axel Persson	Sidney.
Milk River: Chinook division[4]	Alfalfa Valley irrigation district	Chinook, Mont	A. L. Benton	President	R. H Clarkson	Chinook.
Minidoka: Gravity[1]	Minidoka irrigation district	Rupert, Idaho	Frank A. Ballard	Manager	O W. Paul	Rupert.
Pumping[1]	Burley irrigation district	Burley, Idaho	Hugh L. Crawford	do	Frank O. Redfield	Burley.
Gooding[1]	Amer. Falls Reserv. Dist. No. 2	Gooding, Idaho	S. T. Baer	do	P T Sutphen	Gooding.
Newlands[3]	Truckee-Carson irrigation district	Fallon, Nev.	W. H. Wallace	do	H. W. Emery	Fallon
North Platte: Interstate division[4]	Pathfinder irrigation district	Mitchell, Nebr.	T. W. Parry	do	Flora K Schroeder	Mitchell.
Fort Laramie division[4]	Gering-Fort Laramie irrigation district	Gering, Nebr.	W. O. Fleenor	Superintendent	C. G. Klingman	Gering.
Do.[4]	Goshen irrigation district	Torrington, Wyo	Bert L. Adams	do	Mary E. Harrach	Torrington.
Northport division[4]	Northport irrigation district	Northport, Nebr.	Mark Iddings	do	Mabel J. Thompson	Bridgeport.
Okanogan[1]	Okanogan irrigation district	Okanogan, Wash	Nelson D. Thorp	Manager	Nelson D. Thorp	Okanogan.
Salt Lake Basin (Echo Res.)[3]	Weber River Water Users' Assn	Ogden, Utah	D. D. Harris	do	D D Harris	Layton.
Salt River[2]	Salt River Valley W U. A	Phoenix, Ariz.	H J Lawson	Superintendent	F. C Henshaw	Phoenix.
Shoshone: Garland division[4]	Shoshone irrigation district	Powell, Wyo.	M. P. McLaughlin	Irri. superintendent	Geo. W. Atkins	Powell.
Frannie division[4]	Deaver irrigation district	Deaver, Wyo.	Floyd Lucas	Superintendent	Lee N. Richards	Deaver.
Strawberry Valley[3]	Strawberry Water Users' Assn	Payson, Utah	S. W. Grotegut	Manager	E. G. Breeze	Payson.
Sun River: Fort Shaw division[4]	Fort Shaw irrigation district	Fort Shaw, Mont.	E. J Gregory	do	E. J. Gregory	Fort Shaw.
Greenfields division[4]	Greenfields irrigation district	Fairfield, Mont.	A. W. Walker	do	H. P. Wangen	Fairfield.
Umatilla: East division[1]	Hermiston irrigation district	Hermiston, Oreg.	E. D. Martin	do	Enos D. Martin	Hermiston
West division[1]	West Extension irrigation district	Irrigon, Oreg.	A C. Houghton	do	A C. Houghton	Irrigon
Uncompahgre[3]	Uncompahgre Valley W U. A	Montrose, Colo.	Jesse R. Tompson	Acting superintendent	J Frank Anderson	Montrose
Yakima, Kittitas division[1]	Kittitas reclamation district	Ellensburg, Wash.	V. W. Russell	Manager	G L. Sterling	Ellensburg

[1] B. E. Stoutemyer, district counsel, Portland, Oreg.
[2] R. J. Coffey, district counsel, Los Angeles, Calif.
[3] J. R. Alexander, district counsel, Salt Lake City, Utah.
[4] W. J. Burke, district counsel, Billings, Mont.

Important investigations in progress

Project	Office	In charge of—	Title
Colorado River Basin, sec. 15	Denver, Colo.	P. J. Preston	Senior engineer.
Boise-Weiser-Payette	Boise, Idaho	Lester C. Walker	Engineer.
Buford-Trenton	Denver, Colo.	Wm. G. Sloan	Do.
Kings River-Pine Flat	Fresno, Calif.	John R. Iakisch	Constr. engineer.
Western Slope (Colo.)	Denver, Colo.	Frank C. Merriell	Engineer.
Black Hills	do	R. E Kennedy	Assistant engineer.
Eastern Slope (Colo.)	do	A. N. Thompson	Engineer.
Salt Lake Basin	Salt Lake City, Utah	L. O. Larson	Do.
Grande Ronde	La Grande, Oreg.	C. C. Fisher	Do.

Issued monthly by the Bureau of Reclamation, Department of the Interior, as approved by the Director of the Budget. SALLIE A. B. COE, *Editor*



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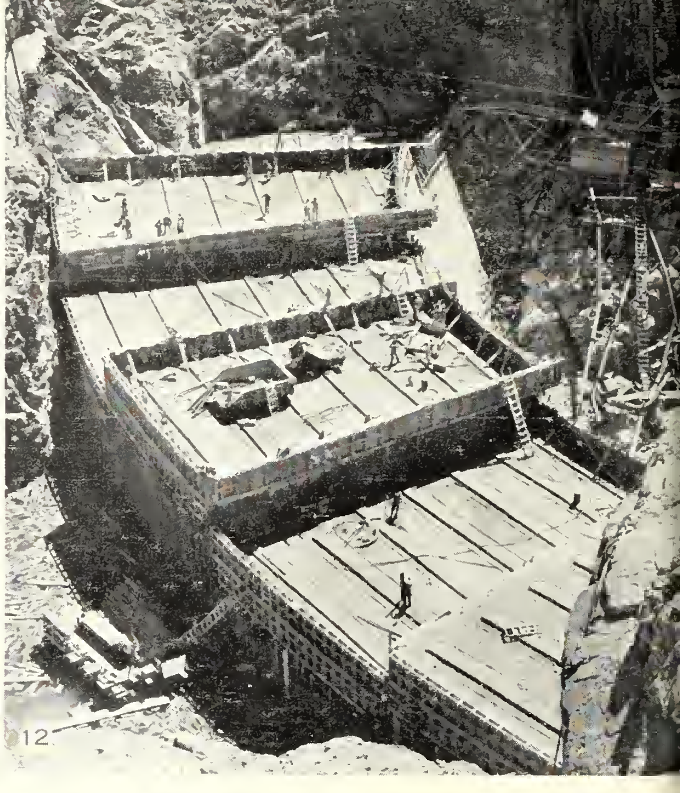

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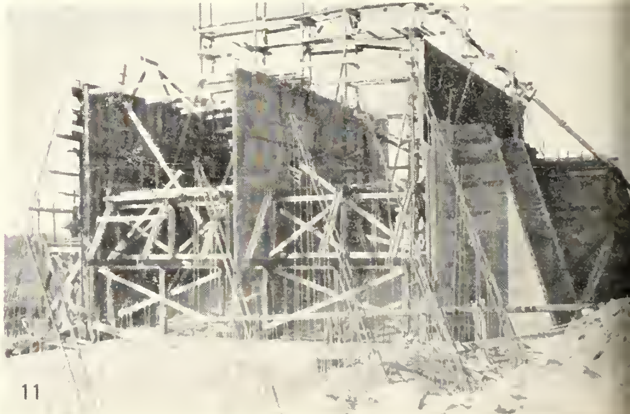

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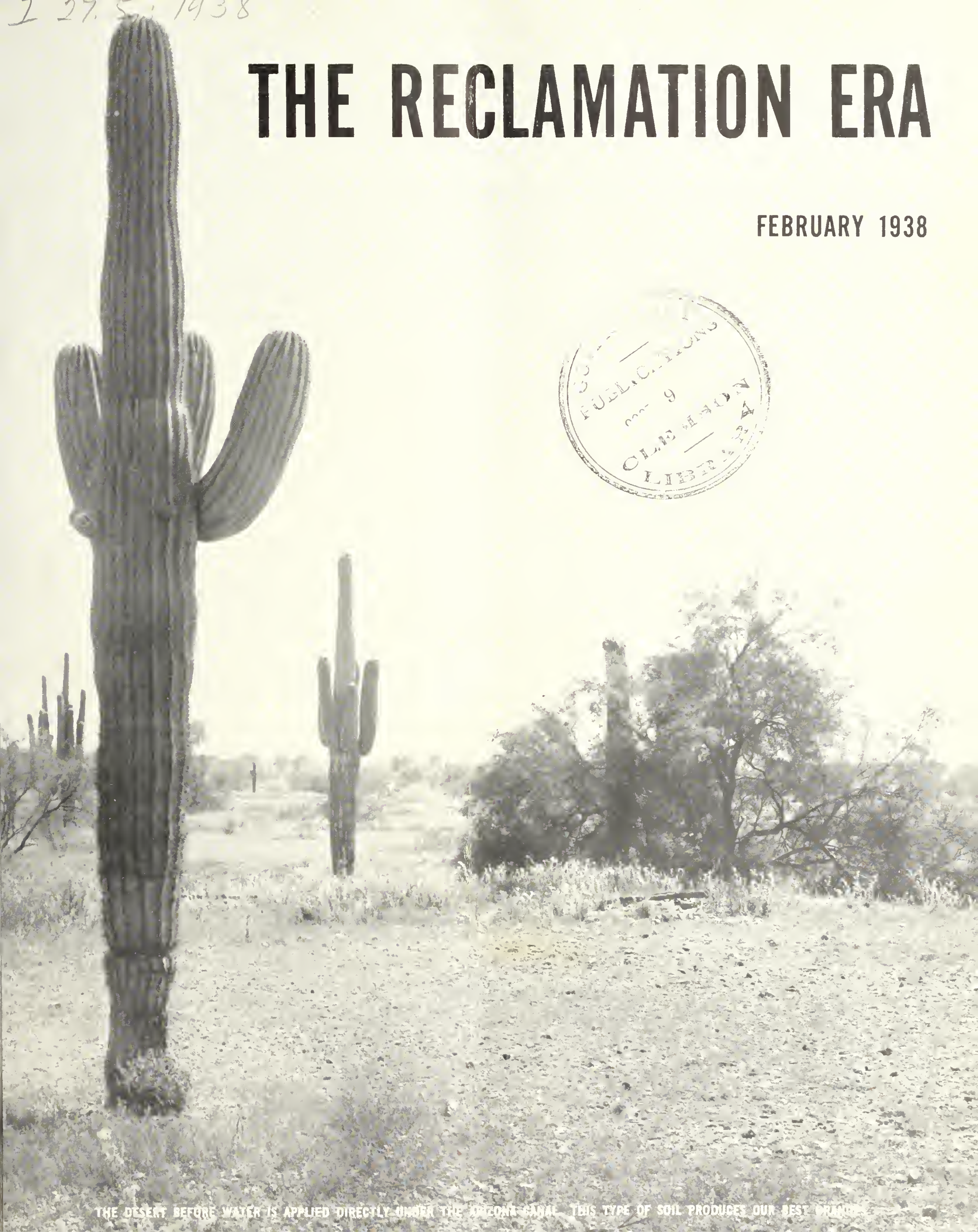
THE RECLAMATION ERA

FEBRUARY 1938



THE DESERT BEFORE WATER IS APPLIED DIRECTLY UNDER THE ARIZONA CANAL. THIS TYPE OF SOIL PRODUCES OUR BEST ORANGES.

OF INTEREST TO WATER USERS

HEARINGS were held on February 1 before the House Subcommittee on the Interior Department appropriation bill affecting Reclamation items. The Bureau's estimates, as forwarded to the Capitol by the Bureau of the Budget, were substantially as submitted.

The Repayment Commission has completed its hearings on the projects and will write its report, containing recommendations, in the Denver office.

Four bills, one in the Senate sponsored jointly by Senators Hayden and O'Mahoney, and three in the House by Representative Hill of Washington, Scrugham of Nevada, and Dempsey of New Mexico, would authorize a new source of income to the Reclamation revolving fund. The bills are not identical, but are similar in purpose to Senate bill No. 3310, which would transfer 52½ percent, amounting to approximately $26,000,000, of naval oil reserve royalties from the General Treasury, together with the same proportion of future accruals, to the Reclamation Fund, canceling therewith the fund's $15,000,000 Treasury loan. It would also cause approximately $250,000,000 of Presidential allotments and General Treasury appropriations, which have gone into Reclamation projects in recent years, to be repaid to the Reclamation Fund rather than to the General Treasury. With the diminished income to the Reclamation Fund from sources set up under the original Reclamation Act and amending and supplemental legislation, this bill, if enacted into law, would augment the revolving feature of the fund in future years and permit the return to the usual procedure of Congress authorizing expenditures from funds on hand.

S. 3310 was introduced in the Senate on January 24, 1938, and referred to the Committee on Public Lands and Surveys.

JOHN C. PAGE, *Commissioner.*

PRICE ONE DOLLAR A YEAR

THE RECLAMATION ERA

VOLUME 28 • FEBRUARY 1938 • NUMBER 2

ELEMENTS OF COST[1]

By JOHN C. PAGE, *Commissioner of Reclamation*

COMMISSIONER PAGE sent a paper to New York City which was read by Chief Electrical Engineer L. N. McClellan of the Denver Office, at the symposium on power being conducted by the American Society of Civil Engineers during its meeting January 20, 1938. Its title is "Elements of Power Cost."

Mr. Page stated that "There is nothing in our situation with respect to power that cannot be rationalized. When reduced to its elements the power question resolves itself into simple terms. I submit these elements, in themselves, are not complicated.

"In general fixed charges are considerably higher for a private than for a public power agency.

"In recent years a number of large multiple-purpose projects involving flood control, improvement of navigation, storage of water for irrigation and domestic purposes, silt storage, prevention of encroachment of salt water into fresh water supplies, and power development have been undertaken by the Federal Government. These are essentially conservation projects of national scope and the power which they make available, while important from the standpoint of defraying part or all of the cost of these projects, is incidental and subordinate to the other more vital functions. These projects are too large and require too much capital outlay to be economically feasible for development by private enterprise.

"The cost of power at these multiple-purpose projects depends largely upon the allocation of cost to the various functions served. For instance, the primary purposes of the Boulder Canyon project are to regulate the Colorado River in the interests of navigation; to provide flood protection for the lower Colorado River Valley, including the rich Imperial Valley in southern California, and to conserve the flood waters which otherwise would be wasted into the Gulf of California, to make them available for irrigation and domestic uses. It seems appropriate to allocate part of the cost of Boulder Dam to items of major Federal interest, and Congress recognized the primary purposes of the project by providing that $25,000,000 of the cost of the project should be allocated to flood control to be repaid out of surplus revenues if any accrue.

"The Grand Coulee project now under construction on the upper Columbia River is primarily a conservation project which will provide water for the irrigation of some 1,200,000 acres of land in the Columbia basin. The reservoir created by Grand Coulee Dam will afford some measure of flood control, will improve navigation and will greatly increase the low flow power output of the present and prospective power developments on the Columbia River below that point. The proper allocation of the cost of Grand Coulee Dam as between the various functions it serves should be considered at the proper time and the cost of power should be established on the basis of the allocation finally adopted. The Shasta Dam on the upper Sacramento River in northern California is another of the large Federal projects on which construction was recently initiated. This project involves flood control, navigation improvement, salinity control, conservation of flood waters for irrigation and domestic uses, and incidentally the development of a large block of power. Here again a proper allocation of the cost of the project to the various functions it serves will be necessary in determining the cost of power.

"It is useless to argue that the Federal Government should not build projects of this type because they also generate power. Social considerations demand their construction and also demand their full utilization, as well, so that the potential energy they create must be developed and made available for use.

"Public agencies have demonstrated in many localities that they can manufacture and distribute power efficiently and successfully with public benefits. Privately owned utilities have served as admirably in many other localities. Remembering that each power project is a separate problem and that because one method has rendered better service in one instance is not conclusive proof that another will not render better service elsewhere—remembering these facts—has not the time arrived for the engineers to concede that inherently there is nothing bad in either public or private ownership of electrical utilities? To accept the fact that either must earn its right to continued existence in any locality by efficient service in the public interest? For the engineering profession to lay aside prejudices, and to apply itself with the precise tools it has available in technical and scientific knowledge to the job of solving the power problem?

"The electrical industry is monopolistic by nature. I hold it to be self-evident that in a democracy a monopoly can be tolerated only so long as the people feel that it serves in the public interest. Is it not time, then, for the engineers, who play so prominent a role in the field of power, to assist, honestly and whole-heartedly, in seeing to it that the public weal is placed foremost among the objectives of the power industry?

[1] Excerpts from paper prepared by Commissioner Page and presented on January 20 at the annual meeting in New York of the American Society of Civil Engineers.

• *Irrigation in Foreign Lands—A 6,500,000-Acre Project in India* •

A FEW months ago the Lloyd Barrage at Sukkur, India, a 6,500,000-acre irrigation project, was completed. The dam, equipped with regulators and sluice gates, has a length of 4,600 feet. Seven main canals of irrigation system radiate from the project. Construction of the canal system and weir required about 210,000,000 cubic yards of excavation. The length of main line canals and branches is 1,600 miles, and there are 4,622 miles of distributing canals, a total of 6,222 miles.

• LETTUCE •

THE first car of lettuce was shipped from the Yuma project on December 3, after which shipments rapidly increased until more than 40 carloads a day were forwarded to market. The quality this season is excellent and the yield from later plantings is reported as high as 175 crates per acre, although the average is not so high.

The Central Valley Project of California

By WALKER R. YOUNG, *Construction Engineer, Bureau of Reclamation*[1]

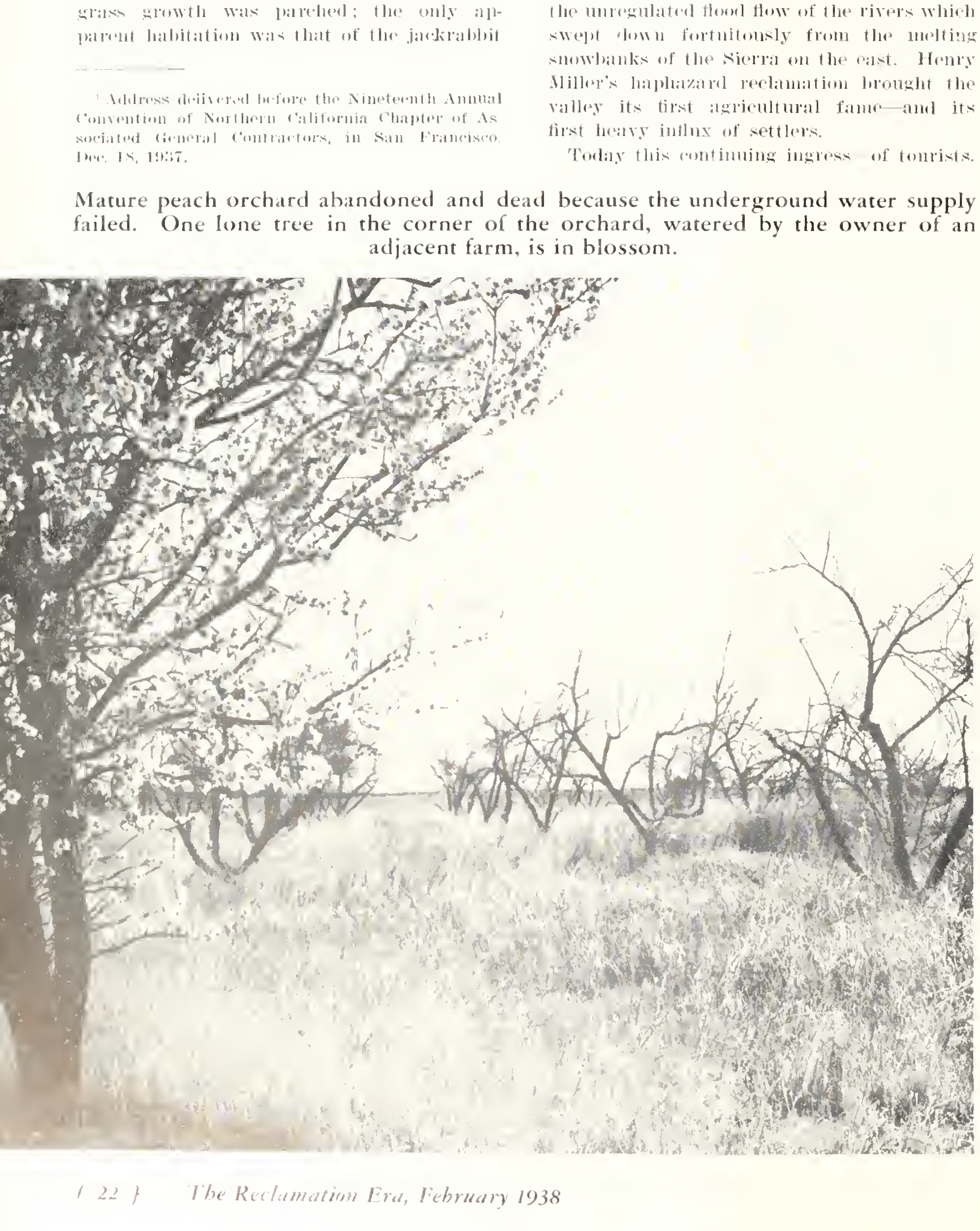
THE first white man to look into the interior valley of California was Pedro Fages, captain of an adventurous band of Spanish soldiers attached to Gaspar de Portola's historic expedition which discovered San Francisco Bay. What Pedro Fages saw when he climbed over a summit of the Coast Range in October 1773, in pursuit of runaway Indian neophytes from Father Juan Crespi's mission at Monterey, was a wide expanse of desert, broken only by infrequent patches of green foliage along the water courses. The valley plain was dry and hot; the short grass growth was parched; the only apparent habitation was that of the jackrabbit and the coyote. Pedro Fages and his soldiers turned back to the coast, leaving the valley to the Indians.

A hundred years later, in the civilization that rose out of the gold rush, Henry Miller looked down from the same Pacheco Pass summit and surveyed with satisfaction his great inland domain. What he, the Cattle King, saw was the valley's second stage of development—broad unfenced stretches of rich range land and, in the distance, extensive stands of shimmering wheat, all watered cheaply each Spring by crude utilization of the unregulated flood flow of the rivers which swept down fortuitously from the melting snowbanks of the Sierra on the east. Henry Miller's haphazard reclamation brought the valley its first agricultural fame—and its first heavy influx of settlers.

Today this continuing ingress of tourists, home-seekers, dust-bowl refugees, and new immigrants—finds the Great Central Valley in its third stage—the era of intensive irrigation. The wheat has given way to more profitable orchards and vineyards; the vast cattle ranches in large measure are planted to alfalfa and cotton. In the 20 counties of the valley have sprung up 83 cities and towns.

[1] Address delivered before the Nineteenth Annual Convention of Northern California Chapter of Associated General Contractors, in San Francisco, Dec. 18, 1937.

Mature peach orchard abandoned and dead because the underground water supply failed. One lone tree in the corner of the orchard, watered by the owner of an adjacent farm, is in blossom.



Regulated Water Supply Urgent

As the Sierra-Nevada is called the backbone of California, so may the Great Central Valley be considered the State's living heart. It includes one-third of the State's area and two-thirds of the State's agricultural lands. It really is two valleys, comprising the basins of the Sacramento and San Joaquin Rivers which meet in a common delta and issue together into the Pacific Ocean through San Francisco Bay. In the valley's semiarid climate the choicest products of the temperate zone and subtropics are grown alike in perfection. Oak and orange trees shade the same blue grass lawn. Roses bloom in December as well as in May. The valley has become an empire of diversified agriculture, settled by an aggressive population of almost a million persons, supported by producing lands representing an investment of more than 2 billion dollars—all dependent upon a single natural resource, water.

Of all the water used in California, over 90 percent is for irrigation; and of the water used in California for irrigation, two-thirds is used in the Great Central Valley.

It is here that the spectre of drought and salinity now rears its ugly head. The valley's bonanza agricultural development has far transcended its unregulated water supply. More than a million acres face an acute irrigation crisis. In the southern San Joaquin Valley the extraction of water from the ground by pumping greatly exceeds the average annual natural replenishment by rainfall and stream flow. Wells are going dry. Between 40,000 and 50,000 acres of producing lands already have been abandoned, and 200,000 acres are in the process of gradual reversion to desert. Another 400,000 acres in the fertile Sacramento-San Joaquin Delta are menaced by intrusion of salt water from San Francisco Bay.

So here it is that one of the greatest of all reclamation dramas is being enacted. The Central Valley Project, assuring these lands a supplemental water supply, is designed to perpetuate the great agricultural investment and prevent threatened retrogression of part of the valley to the first stage—that which Pedro Fages preferred to leave to the Indians.

So much for history. This significant back-

ground of the Central Valley Project explains the nature of our problem. The people of northern California are quite familiar with the symptoms: Periodic flood and drought, a shortage of irrigation water, the blight of saline encroachment, and the interruption of river navigation. I will not burden you with further details.

Problem, One of Conservation

Suffice it to say that the problem, fortunately, is one of conservation, capable of engineering solution. There is water abundant in quantity, as testified by the flood conditions of last week-end. In fact, the Sacramento River is one of the Nation's major streams, producing more water than the celebrated Colorado River. The mean annual runoff of the Sacramento is 21 million acre-feet, while that of the Colorado is 16 million acre-feet. The combined annual discharge of the Sacramento and San Joaquin Rivers into the ocean has averaged about 30 million acre-feet—water enough to cover every irrigated acre in the Great Central Valley to a depth of 10 feet. The Central Valley's water supply needs only proper seasonal and geographical distribution. To meet this challenge the United States Bureau of Reclamation is engaged in this vast construction program. It involves conserving much of the seasonal waste of water by the erection of large storage dams on both the Sacramento and San Joaquin Rivers; and relieving the geographical predicament by a redistribution of the conserved water in a system of canals—so that the Sacramento Valley, which has tributary watersheds producing two-thirds of the water, will accommodate the San Joaquin Valley which has crop lands with two-thirds of the irrigation need.

Now, what does this program mean to northern California contractors, engineers, business executives, and materials men? I know that is your principal interest here today. The best way I can answer your questions is to give you a few facts and figures to indicate what you may expect in the way of construction activity, employment, a market for materials and supplies, and opportunities of wholesale and retail trade in the hinterland of San Francisco whose metropolitan area, according to Prof. George W. Dowrie of Stanford University, has a dependency of 600 million dollars annually upon the Great Central Valley.

The Central Valley Project is in three divisions:

First, the Kennett Division on the north, including the giant Shasta Dam and Reservoir on the Sacramento River above Redding, with a hydroelectric plant feeding a 200-mile transmission line leading to a substation at Antioch, the power load center.

Next, the Delta Division, including a Sacramento-San Joaquin Cross Channel at the eastern edge of the delta, the Contra Costa Canal upon which construction already has started near Oakley, and the San Joaquin Pumping System in the northern San Joaquin Valley.

Then, on the south the Friant Division, including Friant Dam and Reservoir on the San Joaquin River near Fresno, the Madera Canal leading northerly to the Chowchilla River, and the Friant-Kern Canal leading southerly to the Kern River.

Shasta Dam

In the vernacular of Hollywood, the project is gigantic, stupendous, and colossal. You probably read recently an announcement by the Bureau of Reclamation of the proposed size of Shasta Dam. It will be the second largest concrete dam in the world, exceeded in mass only by Grand Coulee Dam now under construction on the Columbia River in Washington, and exceeded in height only by Boulder Dam on the Colorado River. Shasta's height, from the lowest foundation to the top, will be approximately 560 feet—a block of concrete higher than the tallest city skyscrapers in the West. For instance, the tallest buildings in San Francisco are the Russ Building and the Telephone Building, each 435 feet—or 125 feet short of the proposed Shasta Dam. The dam will be long, too—3,100 feet, or about 7 ordinary city blocks, from end to end along the crest.

It is being designed as a gravity-section concrete dam on a slightly curved axis, with a drum gate-controlled spillway over the top. The 10 river-regulating outlets through the dam will be controlled by ring-seal gates. Two of these outlets will be equipped with balanced needle valves to provide for close regulation of flow. Five penstocks will lead to a 350,000 kilowatt hydroelectric plant to be located just below the dam on the west bank. Shasta Reservoir will have a gross storage capacity of $4\frac{1}{2}$ million acre-feet—water enough to flood the entire city of San Francisco to a depth of 167 feet. Required excavation at the dam site is estimated at 3 million cubic yards of earth and rock. The completed dam will contain about 5,700,000 cubic yards of concrete. For comparison, Boulder Dam, including the powerhouses, contains 4,360,000 cubic yards of concrete.

Preliminary estimates of materials for Shasta Dam construction include:

1,200,000 tons of cement—that's over 25 million sacks;

A thriving orange grove in San Joaquin Valley threatened by exhaustion of underground water supply. Contrast this with the picture of the abandoned peach orchard on the opposite page.

12,000 tons of steel gates and machinery;
81,000 tons of steel rails and accessories;
14,000 tons of steel conduits and pipes;
7,000 tons of electrical machinery;
25,000 tons of hardware and tools;
1,250 tons of explosives;
60 million board-feet of form lumber.

Incidental Jobs

A necessary accessory job at Shasta is reconstruction around the reservoir site of 37 miles of the Southern Pacific's main line between here and Portland, Oreg. The new line, 30 miles long, will include 12 tunnels and 8 bridges. One of these bridges, in itself, will be a noteworthy structure—a double-deck combined railroad and highway bridge across the Pit River Canyon, which is later to be flooded. Preliminary designs for the bridge indicate a length of 3,300 feet and a highway deck approximately 470 feet above the present river level—almost twice the height of the San Francisco Bay Bridge roadway above the water of the bay.

Another incidental job is the reconstruction of 15 miles of the Golden State Highway now located within the reservoir site.

Friant Dam

More than 300 miles from Shasta will be Friant Dam, a straight gravity-section concrete dam, 286 feet high, 3,300 feet long on the crest, requiring half a million cubic yards of excavation and 1½ million cubic yards of concrete. Friant Reservoir will have a gross storage capacity of 450,000 acre-feet of water. As at Shasta, the spillway will be controlled by movable drum gates on top of the dam. As at Shasta, the outlets through the dam will be controlled by ring-seal gates and needle valves. Flow into the Friant-Kern and Madera canals will be regulated by balanced needle valves. Initial construction does not include a power plant at Friant Dam. Rough estimates of Friant Dam requirements are for approximately:

320,000 tons of cement;
6,000 tons of steel gates and machinery;
4,400 tons of steel conduits and pipes;
6,400 tons of hardware and tools; and
10 million board-feet of lumber for forms.

Add to these two dams the project's 350 miles of main canals, hundreds of auxiliary structures such as bridges, tunnels, pumping plants, inverted siphons, turnouts, and wasteways—and the sum is a construction program costing an estimated $170,000,000, requiring an infinite variety of heavy machinery and equipment, absorbing raw materials and manufactured products from all over the United States, and giving employment to several thousand persons over a period of several years.

Canals

The largest canal will be the Friant-Kern which, when completed, will extend 157 miles to the Kern River west of Bakersfield. The canal will have a diversion capacity of 3,500 second-feet which will be maintained for the first 30 miles to the Kings River, decreasing to 3,000 second-feet for the section between the Kings River and the Kaweah River. For the first 30 miles, plans call for a reinforced concrete-lined canal 30 feet wide on the bottom with 1¼ : 1 side slopes. It will carry water 15 feet deep and will be 68 feet wide at the water surface. The lining will be 3½ inches thick, requiring some 4,600 cubic yards of concrete per mile. The canal will carry water by gravity at a fall between 6 and 7 inches per mile.

The Madera Canal, which will extend from Friant Dam 40 miles to the Chowchilla River, will have a diversion capacity of 1,000 second-feet, decreasing at the Fresno River to 500 second-feet. There will be provision for possible future enlargement. In its upper reaches it will be a concrete-lined canal 10 feet wide on the bottom with 1¼ : 1 side slopes. It will carry water 9 feet deep and will be 32 feet wide at the water surface. The 3½-inch lining will require about 2,400 cubic yards of concrete per mile. The Madera Canal will carry water by gravity at a fall of about 1½ feet per mile.

The Contra Costa Canal, considerably smaller than the San Joaquin Valley conveyance units, will have an initial capacity of 350 second-feet and will extend 48 miles from the San Joaquin River at Rock Slough to a small reservoir above Martinez. The first 4-mile section, already under contract, is a broad earth ditch—in reality a tidewater extension of Rock Slough to the first of four pumping plants which will lift water a total of 136 feet. The ensuing lined section will be 7 feet wide on the bottom with 1¼ : 1 side slopes. It will carry water 6½ feet deep and will be 23 feet wide at the water surface. The lining will be 3 inches thick, requiring about 1,500 cubic yards of concrete per mile.

It is estimated that construction of these three canals—Friant-Kern, Madera, and Contra Costa—will require from 15 to 20 million cubic yards of excavation; more than 200,000 tons of cement; some 35,000 tons of steel gates and machinery; 2,700 tons of hardware and tools; and 1,600 tons of explosives.

Other project conveyance units, for which plans are still too nebulous to permit a statement of dimensions, are the Delta Cross Channel and the San Joaquin Pumping System. Present plans do not include any project canals in the Sacramento Valley. You understand, of course, that the existing channel of the Sacramento River will be utilized to convey Shasta Dam releases down the Sacramento Valley and to the delta. Construction of the Delta Cross Channel, which ultimately is to have a capacity of about 10,000 second-feet, will be a matter largely of widening and improving existing waterways from the Sacramento River near Hood to the San Joaquin River at the mouth of the Mokelumne River.

The San Joaquin Pumping System will comprise a series of works to successively lift water in artificial and natural channels from the delta up the northern San Joaquin Valley some 135 miles. One plan under consideration, as shown on most project maps, includes five low dams and pumping plants on the lower San Joaquin River between the delta and the mouth of the Merced River, a distance of 72 miles; then four more pumping plants and 63 miles of canal around the west side of the valley to Mendota on the San Joaquin River. Alternate proposals are for a series of pumping plants and canals up the valley trough just west of and avoiding the river channel; or for pumping plants near Tracy and a high-line canal the entire distance around the west side of the valley to Mendota.

Project to Be Self-liquidating

That, in bare outline, is the Central Valley Project. The project is to be self-liquidating. The Government will be repaid by sale of the project's two facilities—water, the primary stock-in-trade, and power, an incidental by-product. Federal funds made available to date have totalled $23,900,000 now partly expended.

A great deal so far has been accomplished, although it is not all apparent on the surface. A long program of preliminary investigation has been completed. In foundation exploration almost 6 miles of tunnels, shafts and drill holes were driven at six potential dam sites. The two sites selected at Shasta and Friant have been proved suitable for the erection of high concrete dams.

Field surveys are well advanced on all fronts. More than 70 miles of main canal have been located and an additional 150 miles of preliminary canal line have been surveyed. Approximately 50 miles of railroad line, on various proposed routes for the Southern Pacific relocation at Shasta, have been surveyed. Right-of-way appraisals have been completed on 15 miles of railroad, 45 miles of canal line, 990 acres at the dam sites, 350 acres of gravel pit lands, and 680 acres of camp sites.

Construction contracts awarded to date, although minor in character, exceed $600,000. They include the initial section of the Contra Costa Canal and the two Government camps. Erection of the Friant Camp, numbering 58 buildings, is almost completed. Erection of the Kennett Camp near the Shasta Dam site is well under way.

The people of California, and the Bureau of Reclamation, too, have been eager to get major construction started. Concern has been expressed over what appeared to be undue delay. But perhaps this apparent delay, in the long run, will show a saving in time. The Bureau of Reclamation has been making progress, all along, toward solution of the delicate problems involved in this com-

plex undertaking. Not all of the progress has been of an obvious type.

Early last month the Board of Consulting Engineers for the Central Valley Project, consisting of Charles H. Paul, consulting engineer from Dayton, Ohio; Dr. Charles P. Berkey, Professor of Geology at Columbia University; Dr. W. F. Durand, professor emeritus in mechanical engineering at Stanford University; and R. V. Meikle, chief engineer of the Turlock Irrigation District, met in Sacramento. They passed upon plans that had been developed as a result of intensive studies by the Bureau of Reclamation that would permit a start of construction on Shasta Dam much earlier than previously anticipated. Their report was approved by the Chief Engineer of the Bureau of Reclamation, R. F. Walter.

With negotiations finally approaching a climax, Mr. Walter and the Commissioner of Reclamation, John C. Page, were here recently to conclude final administrative details necessary to a public announcement of the accomplishments of the preceding months.

As a result of the meeting of the Consulting Board, the recent conferences, and the constant cooperation of the Southern Pacific Co., as well as the State water project authority, it is now the plan to call for bids on Shasta Dam in March 1938. This procedure is predicated upon a new proposal agreed upon by the Bureau of Reclamation and the Southern Pacific, for immediately detouring the railroad through a quarter-mile tunnel under the west abutment of the dam site. Advertisement of this tunnel work is scheduled for next month.

According to the original plan, actual work on the dam itself could not have been undertaken until the substitute railroad around the reservoir site was completed and opened to traffic, and the present railroad in the canyon abandoned. But with the railroad detoured, temporarily, through the tunnel at the dam site, excavation for the dam foundations and the pouring of concrete in the lower portion of the dam can proceed simultaneously with construction of the new permanent railroad around the reservoir site.

This railroad by-pass strategy is significant of the constant behind-the-scenes progress being made on the Central Valley Project. The plan was not conceived overnight. Its development took time. As a direct consequence of its development, we have, not delay, but progress of a very material nature—a saving in time of fully 30 months in starting work on Shasta Dam, the key structure of the Central Valley Project.

NOTES FOR CONTRACTORS

Specification No.	Project	Bids opened	Work or material	Low bidder: Name	Low bidder: Address	Bid	Terms	Contract awarded
761	Kendrick, Wyo.	1937 Dec. 13	Two 72-inch ring follower gates and bellmouth castings for Seminoe outlet works.	Joshua Hendy Iron Works	San Francisco, Calif.	[1] 26,704.00	F. o. b. Sunnyvale, Calif.	1937 Dec. 27
996-D	All-American Canal, Ariz.-Calif.	Dec. 6	8 motor-driven radial-gate hoists and two 3,000-pound capacity double-drum, motor-driven, radial-gate hoists for power drops and New Briar turn-out.	Puget Sound Machinery Depot.	Seattle, Wash	[1] 13,156.00	F. o. b. Seattle	1938 Jan. 4
997-D	do	Dec. 7	30 radial-gate hoists for Pilot Knob check and wasteway, New River crossing, New Wisteria, Woodbine, Wormwood, and West Side turn-outs.	Valley Iron Works	Yakima, Wash	[1] 20,062.00	F. o. b. Yakima, discount 5 percent.	1937 Dec. 29
				Puget Sonnd Machinery Depot.	Seattle, Wash	[2] 9,072.00	F. o. b. Seattle	Dec. 14
1001-D	Burnt River, Oreg.; Moon Lake, Utah.	Dec. 28	Two 12,000-pound capacity gasoline-engine-driven radial-gate hoists for Moon Lake and Unity Dams.	Valley Iron Works	Yakima, Wash.	6,000.00	F. o. b. Yakima, discount 5 percent.	1938 Jan. 3
48,101-A	Shoshone-Heart Mountain, Wyo.	Dec. 6	Steel reinforcement bars, 793,576 pounds.	Carnegie-Illinois Steel Corporation.	Denver, Colo	[3] 20,961.98	F. o. b. Cody, Wyo., discount ½ percent.	Jan. 5
				Knoxville Iron Co	Knoxville, Tenn	[4] 2,201.21	do	1937 Dec. 17
1002-D	Boulder Canyon, Ariz.-Nev.	1938 Jan. 3	Structural steel for supporting structures for transformer circuits.	International Derrick & Equipment Co. of Calif.	Torrance, Calif	6,505.00	F. o. b. Torrance, discount ½ percent.	1938 Jan. 14
1003-D	Truckee Storage, Nev.-Calif.	Jan. 4	Two 50-inch welded plate-steel outlet pipes.	Columbian Steel Tank Co	Kansas City, Mo	8,125.00	F. o. b. Boca, discount 2 percent.	Jan. 12

[1] Items 1 and 2. [2] Item 3. [3] Schedule 1. [4] Schedule 2.

"Parson Tom" of Boulder City Dies

ON DECEMBER 26, Boulder City was the scene of a gathering of mourners to do homage to a beloved and respected pioneer of Boulder City. Rev. Thomas E. Stevenson, affectionately known as "Parson Tom," came to Boulder City from Riverside, Calif., and began his work in the salvation of souls on October 1, 1931. Services were conducted in various houses belonging to the contractors until the Grace Community Church was completed in January 1933.

Under the direction of the Rev. Mr. Stevenson, three boys clubs were formed and operated. Of these the oldest group was called "The Comrade Club," the second group "The Pioneers," which accommodated boys of junior high-school age, while the third "The Friendly Indians" was comprised of boys of the elementary school age. All three groups were active up until the death of their leader.

Parson Tom was killed by a speeding automobile on Christmas Eve. His brother, the Rev. Joseph Stevenson of San Diego, conducted the funeral services from Parson Tom's own church. He was assisted in the final rites by the Rev. Father James H. Terry, vicar of St. Christopher's Episcopal Chapel in Boulder City, and by the Rev. C. H. Sloan, pastor of the First Baptist Church of Las Vegas.

It was a representative group of officials and workmen on Boulder Dam and their families and hundreds of friends wro paid a loving last tribute to this man who made it possible for the early residents of Boulder City to enjoy the comfort of religious services.

The entire staff of the Bureau extends to his bereaved family and friends its sincere sympathy and an assurance that his task was well done at Boulder City.

The Columbia River Salmon Industry[1]

By IVAN BLOCH, *Water Resources Committee, National Resources Committee*

ALTHOUGH the erection of Bonneville Dam, 140 miles from the mouth of the Columbia River, and that of Grand Coulee approximately 450 miles further upstream, have focused the Nation's attention on the threatened salmon of the Columbia, the danger has existed for several years. Increased pollution and silting due to soil erosion have rendered several spawning grounds unfit for the hatching of eggs. The construction of dams has closed the way for spawning fish in many tributaries while overfishing has constantly reduced the number of parent salmon. The situation has emphasized once again the pressing need for the evaluation of all aspects of an undertaking, great as may be its primary objectives.

The fifth ranking industry of the Pacific Northwest, representing a commercial investment of some $15,000,000 and an annual income of $10,000,000, depends upon the yearly catch of salmon. Of the 28,000,000 pounds caught annually, that which is not used directly for food constitutes valuable byproducts as fish meal for the poultry industry and as fish oils in the manufacture of a variety of products. Although in time other industries may advance in relative magnitude, as a result of the development of the Columbia River for power, irrigation, navigation, and flood control, the continued prosperity of the salmon industry is of prime concern to that region.

How can the integrated utilization of this river, more than 1,200 miles long, of which 750 miles flow in the United States, be undertaken with the least detriment to the welfare of those whose activities depend upon a continued supply of salmon? How will it be possible to obviate or minimize the deleterious effects of dams, diversion of water for irrigation, and the pollution which is a function of increased industrial expansion? The answer lies primarily in the ability and willingness with which we can adapt our mechanisms to Nature's desire.

The solution is based not only in maintaining rigorous continuity in the life cycle of the salmon but in adhering as well to the laws which limit infractions upon each of its phases. This cycle begins or ends with the death of the male and female salmon after the necessary acts of egg-laying and fertilization in the cold, clear waters of some distant tributary stream. The eggs constantly fanned by the current of well-oxygenated waters hatch in 2 to 4 months. The young salmon begin a rapid growth, either during their stay in these tributary waters or on their long way to sea. As they finally reach the ocean, they have attained a length of 6 to 8 inches, with all the bodily attributes of speed and vigor. Once in salt water, they begin long travels and reach maturity in 4 to 6 years. At this time, a strange restlessness must possess them, for another long voyage is begun under the impelling urge to return to the place where the originating eggs hatched.

Their bodies are well rounded with fat content and upon reaching fresh water, guided by an unerring instinct, they stop feeding and bend all the power of their tails and fins to forge upstream against the current of the river in a ceaseless struggle to reach the specific originating tributary. As they approach their destination, the fat content of their flesh is exhausted slowly and inexorably. Then, after a few days seeking the perfect gravel bed, with the final consummation in the perpetuation of the race, death follows. Upbellied corpses float downstream to rot, while within the eggs pulses the life process, and the cycle begins anew.

Aerial view of Bonneville project. The spillway dam appears at left; Bradford Island, crossed by fish ladders, in center; and the powerhouse dam at right. A collecting trap, built into the entire downstream face of the powerhouse, connects with the ladder at the north end of the powerhouse, and with the fish locks and fish passage to the navigation lock at the south end. Collecting traps are built into each end of the spillway dam.

Cycle Has Five Primary Factors

There are five primary factors in the cycle. The eggs, in order to hatch, must have a constant supply of cold, clear, and well oxygenated water. The young salmon going to sea follow the downstream current of the rivers. Conversely, the sexually mature salmon tend to swim against such current. The salmon return to the place where the originating eggs hatched. The fat content is a function of the time it takes the salmon to travel from the ocean to the site where it will spawn. Any influence which seriously disturbs any one of these factors in a particular run of

[1] The illustrations accompanying this article are published through the courtesy of the Corps of Engineers.

salmon threatens to extinguish that generation and obviously succeeding ones.

Basically, four dangers exist: Overfishing, diversion for irrigation, pollution and silting, and the building of dams. The first is dealt with and calls for continuous regulation by fisheries authorities. The problems created by diversion for irrigation find a solution in the proper screening of intakes so as to remove the possibilities of fingerling straying into irrigation channels. The most intricate and difficult aspects, however, lie in the obstacles embodied in dams and in the destruction of spawning beds by pollution and silting, aside from the direct effect on fish.

Figure 1 of the Columbia River Basin shows the existing and proposed dam locations. The following table indicates the percentage distribution of the total number of spawning salmon as related to the three present dams, considering Grand Coulee as completed:

Spawning area	Spring-run Chinooks	Fall-run Chinooks	Bluebacks	Total
	Percent	*Percent*	*Percent*	*Percent*
Tributaries below Bonneville	6.1	24.2	------	30.3
Tributaries between Bonneville and Rock Island	32.8	16.2	16.4	65.4
Tributaries between Rock Island and Grand Coulee	0.2	-------	0.2	0.4
Tributaries above Grand Coulee	1.5	-------	2.4	3.9
				100.0

The basin of the Willamette River, emptying into the Columbia near Portland, contains the greatest number of spawning grounds below Bonneville. It is heavily populated and the pouring of domestic and industrial wastes into its waters has caused an acute pollution situation. Inasmuch as more than 30 percent of the total number of spawning salmon depend upon this area it is essential that immediate steps be undertaken to abate the pollution. There is no other way than by the establishment of adequate plants for the treatment of sewage and industrial wastes, of which the latter are the most noxious.

Dangers to Spawning Grounds

In many important tributaries of the Columbia River Basin, pollution and its twin evil, siltation, endanger other spawning grounds. Mines and flotation plants contribute heavy discharges of poisonous chemicals, a condition which can be obviated at a low cost. Soil erosion resulting from abuses of timber and crop land allows the streams to become charged with silt, spoiling gravel beds and destroying not only eggs but the insect life upon which the fingerlings exist. Only proper land use practices can lessen this constantly growing menace. These remedies depend entirely on the willingness of all those concerned to cooperate and to think further

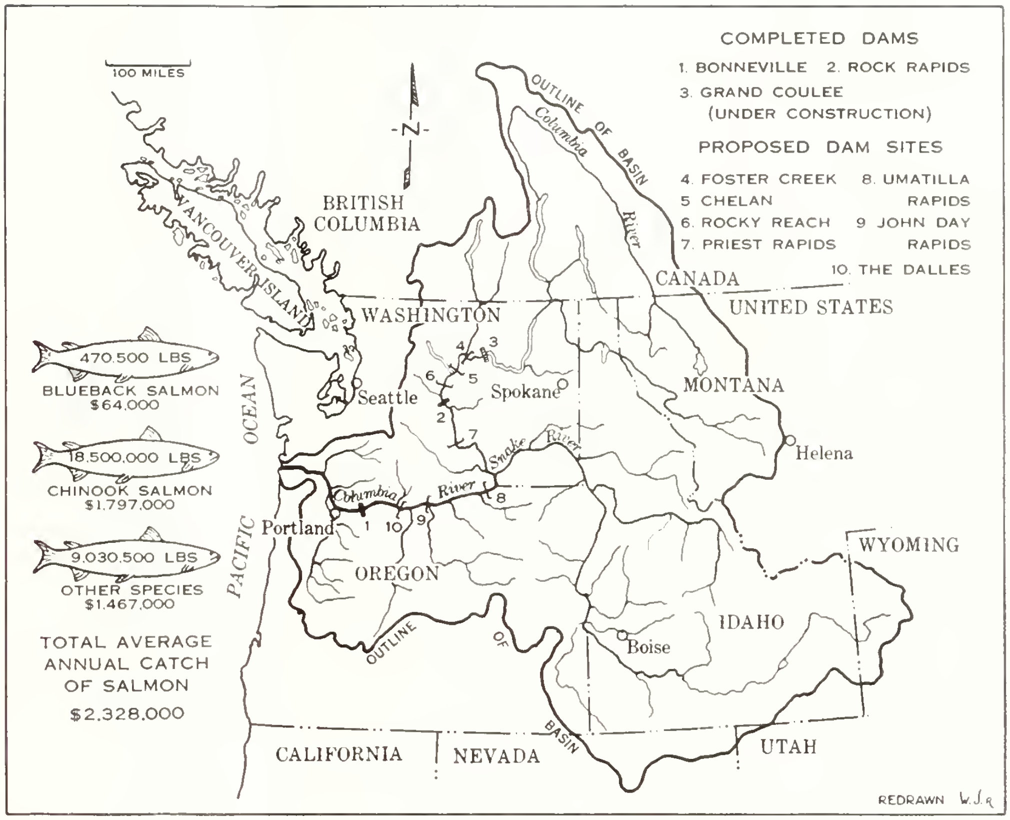


Figure 1.—Columbia River Basin, showing location of existing and proposed dams on Columbia River.

than immediate gains. The lessons in the East should point out what might very well happen if the situation continues. The Connecticut River once had a fine salmon run.

In order to maintain salmon runs over dams, means must be provided for safe upstream and downstream migration with the minimum expenditure of energy for the salmon. Although the use of so-called fish ladders and fish locks or elevators is not new, having been employed successfully both in Europe and North America, the magnitude and ingenuity of the Government's Bonneville installation by the Corps of Engineers in cooperation with Federal and State authorities have never been equalled. As described in the recent report of the United States Department of Commerce Bureau of Fisheries:[2]

"The structures as they now stand consist of:

"(1) Four fish ladders (as wide as a highway carrying four lanes of traffic) one on each side of the main channel at the spillway dam, one at the north end of the powerhouse and one on the Oregon shore, passing around the navigation lock and emptying into Tanner Creek a mile below the dam. (The channel for the Tanner Creek pass has been excavated but it appears unlikely that it will be completed.)

"(2) Passage for fish between the collecting trap and navigation lock at the powerhouse dam.

"(3) Three sets of double fish locks, one on the Washington shore, one on Bradford Island at the end of the spillway dam, and one at the south end of the powerhouse.

"(4) A huge collecting trap built into the downstream face of the powerhouse extending entirely across the structure and connecting with the ladder at the north end of the powerhouse and with both the fish lock and fish passage to the navigation lock at the south end of the powerhouse.

"(5) Two collecting traps of rigid but removable type spanning one gate at each end of the spillway dam and connecting with the adjacent fish ladders and fish lock.

"(6) Three fingerling passes, one at each end of the spillway, and one at the south end of the powerhouse connecting with the ice chute receiving an overflow from the entire face of the powerhouse dam.

"(7) An intricate system of conduits watering and unwatering the fish lock and supplying an auxiliary water supply to the collecting traps and to the lower reaches of the fish ladders.

"(8) A complete system of electric control, manually operated, with power hoists and gantries for the operation of weirs and stoplogs for controlling entrances to the collecting traps and supply of water in the fishways. The estimated cost of completion of these fish-protective works is $6,553,000.

[2] S. Doc. No. 87, 1937. Bonneville Dam and Protection of the Columbia River Fisheries

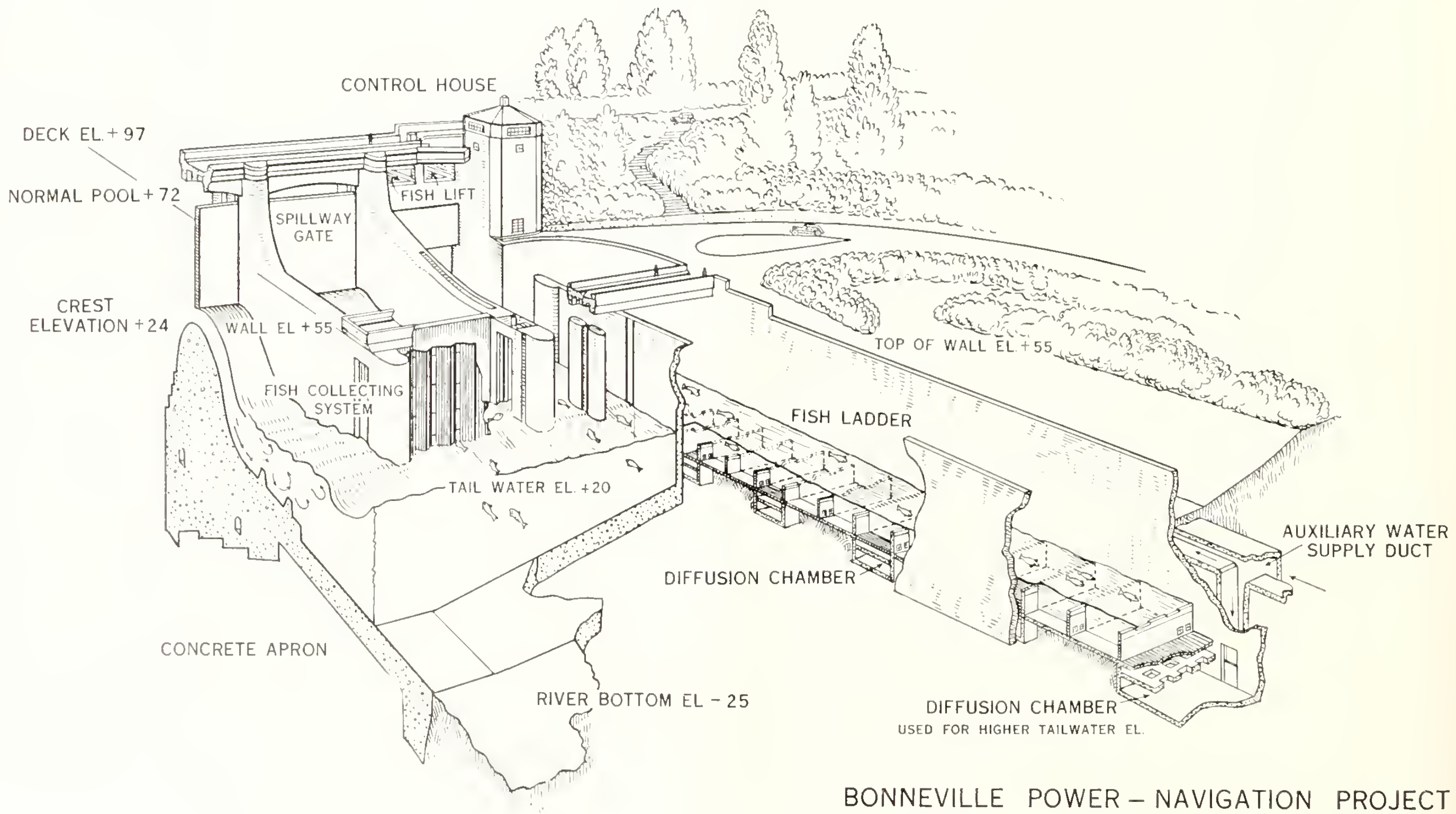
Bonneville Dam. Looking upstream through temporary fish ladder in bay No. 18 at south end of spillway dam.

Fishways

Figure 3 schematically portrays a typical collecting system with a fish lock and a fish ladder. The fish ladder consists of a series of successive pools, so that salmon migrating upstream can make the total climb averaging 50 feet, in 75 easy stages, in the water spilling from pool to pool. However, as the water level below the dam will vary some 40 feet according to conditions of low or high water, it was necessary to enclose the ladders with high concrete walls and to provide for a constant water supply to the ladder system, so as to maintain constant flow velocities and the same entrance location to the ladders for all conditions of river level.

Fish Lift and Collecting System

The fish locks or elevators, as shown in figure 2, are similar in principle to navigation locks. Salmon are attracted into the special locks by water flowing from the filling system. At the appropriate time, determined by attendants at the controls, the entrance gate is closed and the lock is filled with water, until the level within the lock is the same as that at the upstream dam face. A sloping, slatted floor is raised slowly with



BONNEVILLE POWER – NAVIGATION PROJECT

FISHWAYS AT SOUTH END OF SPILLWAY DAM

CORPS OF ENGINEERS U. S. ARMY

SECOND PORTLAND DISTRICT - (OREGON)

FIG. 2

the water in the lock so that when the exit gate opens, the trapped salmon will swim out. The exit gate is then closed, the lock is emptied of water and the process is repeated. The time required for a complete cycle of operation at each lock is 15 minutes.

It is necessary to attract upstream migrating salmon to these various structures. To achieve this, use is made of the basic principle that these salmon swim into moderate current, rather than into either slack or high velocity water. The collecting systems create the most favorable current in the river and their function is complemented by the proper operation of the dam spillway gates so as to assure a concentration of salmon at the right places.

Above the dam, the salmon will continue up the river. No pool of quiescent water will tend to halt them, for although the river level has been raised by the dam structure, its velocity has been reduced to not more than half its original value.

Downstream migrants will overcome the obstacle presented by the dam in several ways. Actual tests have been made which show that no interference will be experienced, nor will the fingerlings be injured in their downstream hurdle. Those which pass through the ship-propeller type turbines, revolving at the low rate of 75 revolutions per minute will reach the tail waters none the worse for the experience. Others will go over the ice chute, which collects the surface water layer over the entire power dam. The intakes of the auxilliary water supply being screened, no salmon will be drawn into that system. Although the descent through the spillway gates at the spillway dam will be rapid, it is known that the change in pressure which accompanies this drop is not harmful to the small fish.

Thus ample passage has been provided for the salmon at Bonneville. It is true that upon the start of construction much concern was expressed as to the suitability of the provisions for fish ladders and locks. After considerable consultation and several changes in design, a compromise was reached which today gives all those concerned reasonable assurance that Bonneville will not prove to be unsurmountable.

The next man-made obstacle on the Columbia River is the existing dam of the Puget Sound Power & Light Co. at Rock Island, 330 miles from Bonneville. There, sets of ladders now in operation have functioned satisfactorily for a few years without detriment to the salmon. Therefore, it appears evident that the technique of providing passage for the salmon over dams is sufficiently well established to be used on any other proposed structure.

However, a serious limiting factor develops in that the salmon's fat-content from which it derives its energy, is a function of the time it takes the salmon to swim upstream from the ocean to the specific spawning grounds. For example, salmon originating from the furthest tributaries in British Columbia are the heaviest. If the time for the upstream run is increased through the added struggle to pass over dams, the salmon will be exhausted before they reach their destination. Although they may seek new spawning grounds, the majority will die without fulfilling their final function.

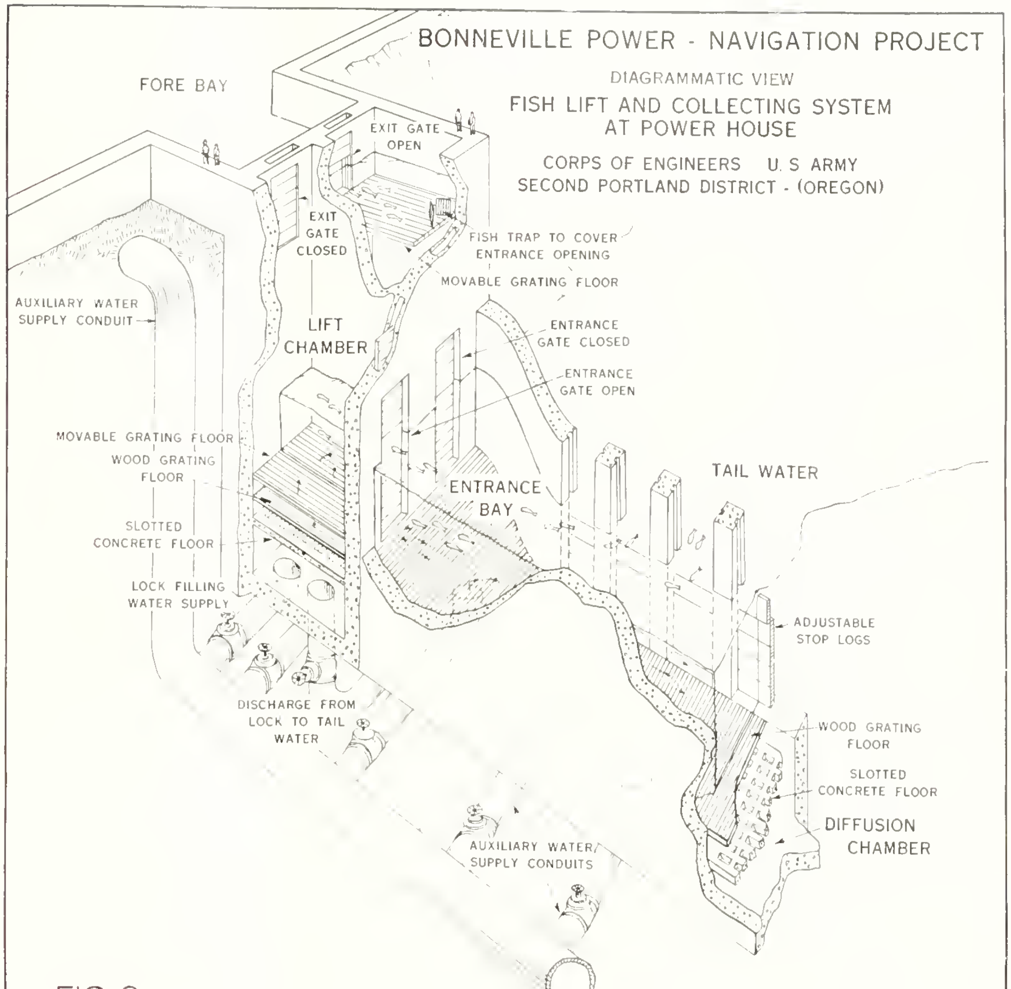


FIG. 3

Plan to Preserve Salmon at Grand Coulee Dam

Furthermore, inasmuch as the height and design of the structures at Grand Coulee will preclude the economical construction of ladders or elevators, that dam presents a blank wall, with no physical means for overcoming it. The choicest salmon runs would become extinct if it were not for the many years of actual experience of the fish biologists and culturists in establishing new runs. The fact that salmon return to the place where the originating eggs hatched, as compared to where they were laid, has permitted a most successful operation to take place. Mature salmon, ready to spawn, are trapped and their sexual product are obtained. The fertile eggs are transplanted to tributaries possessing all the requirement for hatching and providing new salmon runs in this fashion. It is planned to use this system to prevent a loss to the salmon industry from the building of Grand Coulee Dam. In time, and as new dams are constructed, new runs will be started, which will condition salmon to the new time bases. By selective breeding, certain species and individuals will be produced which may furnish an even more desirable type of salmon.

Thus the present and future problems are faced. There is reason to believe that the number of salmon will continue to be maintained satisfactorily. But the Columbia River salmon situation is a long-term one, and the development which is starting will add year by year to its problems and intricacies. Each new dam, even if provided with fish ladders and elevators, will increase the time which an old run will face. The consequent exhaustion of spawning salmon will no doubt increase the necessity for transplanting eggs.

It is not enough to understand the mechanics of fish ladders and elevators, or the biologic factors which make for successful egg transplantation. A mass of closely correlated information will be needed, not at the spur of the moment, but along progressive,

Bonneville Dam. Collection channel along face of powerhouse.

planned approaches. Suitable spawning grounds must be selected, geared to the river's development. The building of new runs must be correlated to the completion of dams to be erected, and pollution and silting must be kept within constant control for these new grounds.

Inasmuch as the development of the Pacific Northwest "empire" is still in its infancy, rigorous and comprehensive planning, based upon the unbiased interpretation of facts, can overcome this and other difficulties. The people of the Pacific Northwest are keenly aware of their problems and through the active work of their county, State, regional, and Federal planning agencies, as well as by individual and group action, are laying the foundation for an intelligent approach to the use of the abundant natural resources of the northwestern corner of our Nation. The success of the effort will be watched by the world as an example that man can manage his planet by making use of his intelligence and knowledge when it subordinates his otherwise reckless desire to ravish his natural resources.

SALE

of Salt River District Bonds

PRESIDENT LIN B. ORME, of the Salt River Valley Water Users' Association, has announced the award by the Salt River Project Agricultural Improvement and Power District of $3,197,000 of the district bonds, maturing January 1948 to 1964, to a syndicate headed by Blyth & Co., to carry a coupon of $4\frac{1}{4}$ percent at a price of $97.07 and accrued interest, equivalent to a net interest rate of about 4.47 percent. The proceeds will be used to retire the association's "refunding issue," which carries interest at the rate of 6 percent. The association has called this issue for retirement. It was sold in 1930 at a price of $92, resulting in a net interest rate of about 6.65 percent.

In accepting the bid at $4\frac{1}{4}$ percent, the project rejected an alternate bid at $4\frac{1}{2}$ percent for bonds at 100.02 submitted by the same syndicate. The association's bond counsel, Messrs. Chapman and Cutler of Chicago, advised the association by telegraph that the bid of $4\frac{1}{4}$ percent was the "best bid," as defined by the statute, and the action taken was in accordance with that opinion.

This is the first occasion on which the project has received a bid at par or better, and the rate of $4\frac{1}{4}$ percent is the lowest in the project's history.

Technical Memoranda

567. Experimental study of effects produced by uplift in a cracked cantilever of a thin arch dam, Eldred D. Smith, Nov. 24, 1937, 18 pp., illus. and charts. Price, $4.
568. Trial-load analysis of the arch barrel for Bartlett Dam, Sidney D. Larson, Dec. 17, 1937, 9 pp., charts. Price, 10 cents.
569. Trial load twist analyses of the high Marshall Ford Dam—joints not grouted, Fred A. Houck, Dec. 17, 1937, 16 pp., and charts. Price, $1.

• YAKIMA •

YAKIMA, county seat of Yakima County, in the rich Yakima Valley, has nearly 30,600 population and is the queen city of one of the Pacific northwest's most prosperous irrigated districts. It has gained 7,000 since 1930.

Its produce row extends for one mile, with warehouses, cold storage plants, and offices. Fruit or vegetables in carload lots roll out every day of the year.—*The Spokane Spokesman-Review.*

PROGRESS

of Investigations of Projects

Kings River-Pine Flat project, California.—Data were collected by the Kings River Water Association, an analysis of which will form an important part of the investigations.

Blue River transmountain diversion, Colorado.—All the eastern slope surveys were completed. Specifications were prepared covering geophysical surveys of the various features of the project. Maps, cross-sections, and report on the tunnel sites between Blue and Williams River and at Floyd Hill were completed, and partially completed for the Continental Divide tunnel site. Draft of report on water supply and power features is in progress.

Colorado-Big Thompson transmountain diversion, Colorado.—Studies were made to determine the power output of the lower Green Mountain power plant, and estimates were made as to the amount of power available during construction of the Green Mountain Dam. Corona and economic studies were made for the Dillon-Grand Lake and Loveland-Estes Park transmission lines.

Eastern Slope surveys, Colorado.—Topographic surveys were under way on the Smoky Hill River project. Reports on the Trinidad, North Republican, and Cherry Creek projects were in progress.

Western Slope surveys, Colorado—(a) *Collbran project.*—Estimates of yardage in the proposed United Mesa Canal were completed, and water-supply studies were in progress.

(b) *Florida project.*—Detail topography was taken at the lower alternate dam site on the Florida River, and diamond drilling was completed at the Miller Creek dam site. Test pits were completed, with percolation tests, at the Miller Creek site and nearly completed at the lower alternate site.

(c) *La Plata project.*—An operation study was made to determine the water available for the project.

(d) *Paonia project.*—Topography was taken of a pump site between the Stewart Lateral and the Minnesota ditch.

(e) *Piceance project.*—Field report was completed and water-supply studies were being made.

(f) *Silt project.*—Maps and estimates for the construction of the proposed Timberline Canal were completed.

(g) *Troublesome project.*—Water-supply studies were being made on this project.

(h) *West Divide project.*—Report on this project was completed.

Cabinet Gorge investigations, Idaho.—A drilling program was outlined and arrangements made for drilling to begin early in 1938.

Snake River Storage—South Fork, Idaho.—The planetable sheets of the Narrows dam site were completed.

Southwest Idaho investigations (Boise-Weiser-Payette).—Permanent bench marks were established in the Mountain Home area. Topography of the Cascade reservoir site was completed. A supplement to the preliminary geological report on the Twin Springs dam site was prepared. A geological examination was made of the line of the proposed tunnel from Horseshoe Bend to Dry Creek. A general map of the Weiser Valley was prepared. Study was made to determine the spillway, outlet, and construction diversion requirements of storage reservoirs on the North Fork of the Payette River. Work was continued on designs and estimates for a concrete gravity type of dam at the Cabarton site.

Buford Trenton investigations North Dakota.—All field work was completed.

Altus project surveys, Oklahoma.—Readings of the gage height of the Altus Reservoir were continued. The report on the investigations was completed.

Kenton project, Oklahoma.—Topography was taken on the Kenton Dam and reservoir sites and cross-sections were taken of the Cimmaron River below the dam site. Land classification was continued, and preliminary canal line was run. Water supply studies were continued.

Canby project investigations, Oregon.—Boundaries of the irrigable areas were determined and mapped.

Grande Ronde investigations, Oregon.—Work on the planetable sheets of the Sanderson Springs reservoir site and feeder canal was practically completed. Cross-sections of Grande Ronde River and certain tributaries were plotted. Diamond drilling of the river channel at the lower end of the valley was completed. The survey of the relocation of the railroad was completed.

Black Hills investigations, South Dakota.—Studies of rainfall and run-off on the Rapid Creek watershed and operation studies of the Pactola Reservoir from the standpoint of flood control were made. A study was made of storage requirements and reservoir possibilities on the Belle Fourche River.

Utah-Idaho-Wyoming investigations Green River-Bear River surveys. Field reports on the preliminary surveys of the Green River-Hoback Canyon Diversion, Kendall-Bear River Canal, Kendall-South Pass Canal, South Pass-Red Desert Canal and LaBarge-Fontenelle-Hams Fork-Bear River Canal were completed.

Utah investigations—(a) *Dixie project.*—The report on these investigations was submitted to Washington and the Utah Water Storage Commission.

(b) *Gooseberry investigations.* The data on these investigations were assembled and water supply studies begun.

Colorado River Basin investigations—(a) *White River, Colo.* Classification of undeveloped lands along the White River was completed.

(b) *Lower White River project, Colorado.*—Horizontal control on this area was continued with the location of land corners and the running of stadia traverse. Field sheets were prepared and classification was carried on.

(c) *Fremont River, Utah.* Mapping of irrigated lands in the Fremont River drainage area was completed.

(d) *East Fork of Virgin River and Kanab Creek, Utah.*—Mapping of the irrigated areas along the East Fork of the Virgin River and Kanab Creek was continued. Field sheets of the Thompson project, Green River-Lower San Rafael, Colorado River, Monticello, Blanding and Bluff areas were forwarded to Denver for the preparation of general maps.

List of Articles on Irrigation and Related Subjects

BOULDER DAM POWER

Hydrogeneration of energy, illus., by Frank H. Rogers, Proc. A. S. C. E., Vol. 63, No. 10, pp. 1893–1911. (Views of Boulder Dam generators.)

COLORADO-BIG THOMPSON PROJECT

Colorado-Big Thompson reclamation project in Colorado approved by President and Secretary of the Interior, Exten. Remarks by Hon. Lawrence Lewis, Cong. Record, Jan. 4, 1938, Vol. 83, No. 2, pp. 35–36.

CROWNOVER, C. E.

Crownover describes Roza Project, Pacific Boulder and Engineer, Dec. 1, 1937, Vol. 43, No. 19, p. 44.

GRAND COULEE DAM

Plans for completion of the Grand Coulee Dam, illus. Western Construction News, Dec. 1937, Vol. 12, pp. 479–82.

Grand Coulee High Dam, plans, Eng. News-Record, Dec. 23, 1937, Vol. 119, pp. 1021–1024.

Empire building—Editorial, Eng. News Record, Dec. 23, 1937, Vol. 119, p. 1009.

HOUCK, FRED A.

Trial-load twist analyses of the High Marshall Ford Dam, joints *not* grouted, Technical Memorandum, No. 569, Dec. 17, 1937, 16 pp. with numerous charts. Price, $1.

ICKES, HAROLD L.

Completion of the Grand Coulee Dam, address on the opening of bids on the dam, Dec. 10, 1937. Cong. Record, Dec. 13, 1937, Vol. 82, No. 23, p. 1879.

The Grand Coulee Dam, Dec. 10, 1937. Extension of remarks of Hon. Homer T. Bone, Cong. Record, Dec. 14, 1937, Vol. 82, No. 24, pp. 2001–2002.

KENNEDY, R. E.

Subject index of Technical Memoranda Nos. 1–560, Denver, Colo., Dec. 10, 1937, 32 pp. Mimeographed.

KINZIE, P. A.

The Penstocks at Boulder Dam, illus. and inset of drawings. Engineering (London), Dec. 24, 1937, Vol. 144, No. 3754, pp. 703–706, 716, and inset double page. (Fourth article of series by Bureau of Reclamation officials.)

LARSON, SIDNEY D.

Trial load analysis of the arch barrel for Bartlett Dam, Tech. Memo. 568, Dec. 17, 1937, 9 pp., including charts. Price, 10 cents.

NEUBERGER, RICHARD L.

The world's greatest engineering wonder, illus., American Magazine, January 1938, Vol. 125, No. 1, pp. 14–15, 134–137.

PAGE, JOHN C.

Grand Coulee Dam and irrigation (address on opening bids of Grand Coulee Dam at Spokane, Wash., Dec. 10, 1937). Extension of remarks by Hon. Chas. H. Leavy, Cong. Record, Dec. 14, 1937, Vol. 82, No. 24, pp. 2017–2018.

Plan to save 2 years on building Shasta Dam for water project, Southwest Builder and Contractor, Dec. 17, 1937, Vol. 90, No. 25, p. 14.

One-third of west ill watered, only hope of development in irrigation (Coulee bid opening), Southwest Builder and Contractor, Dec. 17, 1937, Vol. 90, No. 25, p. 15.

PARKER BRIDGE

Armored steel trestle, Flood control by Boulder Dam makes possible new low-cost crossing near Parker Dam, illus., Eng. News-Record, Dec. 16, 1937, Vol. 119, pp. 985–7.

SAVAGE, J. L.

Special Cements for Mass Concrete, illus. and charts, prepared for the consideration of the Second Congress of the International Commission on Large Dams, World Power Conference, Washington, D. C., 1936, 230 pp. Price, 75 cents.

SMITH, E. D.

Experimental study of effects produced by uplift in a cracked cantilever of a thin arch dam, Tech. Memo. No. 567, Nov. 24, 1937, 48 pp., illus. Price, $1.

SYKES, GODFREY

The Colorado Delta, illus., and map. Carnegie Institution Publication No. 460, 1937, 193 pp., indexed.

TAYLOR, EDWARD T.

Regionalization of National Resources (Mansfield bill), Cong. Record, Dec. 21, 1937, Vol. 82, No. 30, pp. 2687–2692.

VETTER, C. P., *Chairman*

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The Menacing Morning Glory

THE spread of morning glory has alarmed many in rural sections and more attention is being given by agricultural commissioners to the control of this weed as well as other pests. Just now a good many bean fields are being checked for the presence of morning glory infestations with the idea of doing everything possible to prevent the transportation of bean straw which may be harboring the seeds of morning glory. If certain piles of such bean straw can be quarantined it may be very helpful in checking the spread of this pernicious pest.

The feeding of bean straw to animals and the distribution of bean straw for manure to orchards furnishes an ideal means of spreading the pest. Various control methods including cultivation, sprays, and the jar method in scattered spots, are being used vigorously.

To illustrate the damage which can be caused when morning glory gets away, let us take the case of a 1,000-acre bean ranch in San Diego County. Morning glory infestation had become so general that the growing of beans had to be discontinued and the land is now planted to grains. This has resulted in a net loss of annual income amounting to \$15,000 and from the standpoint of the county as a whole assessed valuation is reduced in the shift from the classification of bean land to grain land. In addition to the loss mentioned, a great deal of money has been spent in attempts to eradicate the pest.

In many parts of California morning glory is on the point of getting away and it is of great importance to use every effort to keep it under control. In many instances morning glory has gotten out of hand because of poor methods, lack of knowledge of the plant and its habits, and the use of worthless treatments. It is of vital importance to get the details right. Some methods used greatly aid in scattering morning glory all over the place. Carelessness may result in injury to trees or other crops through the use of sprays and other chemicals. The use of the jar method for poisoning is satisfactory in restricted areas. Larger fields may be summer fallowed and gone over with a weed knife weekly prior to planting a close grain crop.

By way of review we are publishing herewith the recommendations for control of morning glory as published in Circular 97 of the California Agricultural Extension Service:

The common or wild morning glory, undoubtedly the most serious and most pernicious weed in California today, infests every county where agriculture is extensive. It invades our choicest land and, so far, has defied all efforts to depose it. Its presence may not necessarily be, therefore, an indication of poor farming.

Morning glory is a perennial that renews its growth from year to year from its underground stems and roots, and through the spread of these subterranean structures rapidly widens its areas of infestation. Ordinarily it starts in a field from seed. Its rapid spread in the early years of farming in California was probably caused by the sowing of uncleaned wheat and barley seed. It is almost impossible to remove morning glory seed from these cereals because of the similarity in seed size. Grain farming affords this pest an excellent opportunity to produce seed and thus to become established.

The root of the plant will, under favorable conditions, penetrate the soil to a distance of 20 feet or more. From the main root and shallow laterals, new shoots come to the surface, so that the plants spread vegetatively in an everwidening circle. The seed, being produced in abundance, rapidly increases the infestation and is in fact the most important means of dissemination. From a small area the pest can quickly be spread over a field by the tillage implements, which drag vines bearing mature seed. The underground parts torn loose by the implements and carried for considerable distances may, if embedded in moist soil, also start a new infestation; but the spread in this way is small compared with the spread by seed.

Morning glory seed probably retains viability in the soil for many years. Though data on wild morning glory (*Convolvulus arvensis*) are not available, in trials with a closely related species, seed buried at depths of 8, 22, and 42 inches showed germinations of 27, 41, and 43 percent, respectively, after 20 years. Where morning glory has become established, therefore, one must not only destroy the established plants but also prevent recurrence from seed that has lain dormant in the soil.

Control of Morning Glory

Although morning glory has received attention for many years, no completely satisfactory or economical method of control has yet been devised. As experiments show, the pest can be checked or almost completely exterminated, but only with a considerable expenditure of time, labor, and money.

Morning glory has been attacked in several ways. Cultivation, smothering (either with a smother crop or with nonliving material), cropping methods and chemical herbicides have been used with varied results. All these methods are useful, and often two or three may be combined. Pasturing and flooding have also been tried, with indifferent success; but such methods are, at best, applicable only under special conditions.

The numerous attempts to eradicate morning glory by cultivation have met with some success and many failures. Poor results can be attributed to careless or incomplete treatment. The underlying principle in eradicating perennials by cultivation is that the development of the green leaves must be prevented. A second rule is to continue cultivation until the reserve food material is used up in the new growth or until underground parts are starved to death. Poor results are usually attributable to failure to prevent leaves from developing, for even a small leaf surface will soon manufacture and store in the root sufficient food material to undo the effect of several cultivations. The best procedure is to cultivate at definite intervals, often enough so that no new shoots reach the light and to do the work faithfully. Just how often the field must be weed-cut depends on the depth of cultivation, the season, the amount of reserve food in the roots, and perhaps certain local conditions. With the ordinary depth of cultivation of 4 to 6 inches, the intervals cannot be more than one week; and during the summer heat, when growth is most rapid, cultivations must be more frequent.

During July and August, according to observations at Davis, shoots from plants cut off at a depth of 16 inches will reach the surface in 10 to 12 days. Cultivation must begin in the spring as soon as the growth starts and must continue until growth definitely stops in the late fall or early winter. On shallow soils or soils with a high water table, where all root development is near the surface, less time is required to eradicate morning glory than on soils that permit deep root penetration. Under the former condition, some farmers have reported eradication in a single season. At Davis, however, on a Yolo sandy loam soil, plants were still thriving and producing vigorous shoots after 3 years of clean cultivation. On the latter type of soil, morning glory grows luxuriantly, and eradication by cultivating is obviously slow.

The implement most suitable for cultivating morning glory is the straight-blade weeder, kept sharp and in good cutting condition. The field should be plowed rather deep in the early spring, and the soil worked down thoroughly. If a deep layer of soil is thus provided at the start, the weed cutter can be run at the necessary depth more easily than if the plowing had not been done. When weed-cutting the field, the weeder must be lapped at least 18 inches to 2 feet to insure the cutting of all the shoots. Care and eternal vigilance are the price of success in controlling morning glory by eradication.

Nonliving materials, such as tar paper and straw manure, when used to control morning glory by smothering, have generally failed. Though tar paper, properly lapped, has

(Concluded on page 34)

WILD WESTERN RIVERS

By JOHN C. PAGE, *Commissioner of Reclamation*[1]

THE rivers of the United States generally are of two types, and these types usually are not intermingled. Virtually all of the streams of the humid sections are perennial, while in the arid and semiarid western third of the Nation nearly all streams are of intermittent flow.

The control and use of the waters of our rivers involve problems much the same everywhere, except that in the West, where intermittent streams must be dealt with, water is scarce. The importance of its conservation and wise use is magnified by this fact.

A gentle, docile river is a prized possession of any locality. While many of the streams of the humid sections have these qualities almost to cowlike proportions, the rivers of the arid West are more likely to have the characteristics of wild bulls, being unreliable, treacherous, and, at times, vicious.

Any river, like any cow, is liable to become intractable at times and figuratively kick over the bucket and spill the milk. Even in the humid regions some are given to more frequent fits of temperament than others, and some are, apparently, more averse to domesticity, since they seem to grow more fractious the longer we tend them. In the West, however, nearly all streams, if they were cows, would be of the long-horn variety which the cowboys have to rope and hogtie to milk.

Wasted Water

The problems of flood control and river regulation, therefore, are with us whether we live in Bangor Maine, or Los Angeles, Calif. The principal difference in these problems as they exist in the humid and in the arid regions is that the people of the West, in some respects, have much more at stake in their rivers. Floods out there mean not only damages to property, disruption of the normal tenor of human activities, and, perhaps, loss of human life, but they mean also that precious water is being wasted.

Up to a given quantity, water is just as valuable in one section as another, but in humid regions ordinarily such great quantities are received in excess of what is actually needed that little thought is given to its value. In the West, there is never enough, over the period of a year, to fill all the demands which the population makes or would like to make upon the supply; so there the value of water jumps to amazing figures. This value is quoted in terms of money, and water is the subject of controversies between individuals, between communities, and between States and regions.

Since water generally is considered in its relationship with its greatest utility, the problem of the West usually is described as an irrigation problem. It does have other aspects, as well. In certain areas flood control is paramount, in others navigation. It is true, however, that generally in the West these are subordinated to the problem of regulating streams to provide and assure adequate domestic and irrigation supplies.

Work of Reclamation

Since 1902 the Bureau of Reclamation has been the principal agency in the field of water control for irrigation in the West. In that time it has built 138 dams and about 20,000 miles of canals for the irrigation of almost 3,000,000 acres of land. It now has a great construction program under way, which, when completed, will provide reliable water supplies for an additional 2,500,000 acres of dry lands and which will provide supplemental water supplies for extensive irrigated areas now dangerously short of water.

An understanding of the problems of the various sections of the United States is essential to appreciation and sound appraisal of what the Federal Government has attempted to do. The water problem of the West is generally not understood outside that region.

From the 100th meridian to the Pacific coast, virtually all the land is arid or semiarid, receiving on the average less than 20 inches of rainfall a year, much of it as little as 3 inches. Agriculture there cannot safely proceed beyond the pastoral stage without irrigation. At present almost 20,000,000 acres are irrigated out of the 700,000,000 acres in this region. The water supply is so severely limited that with complete development of all the rivers only about 10,000,000 acres more can be added to the total of irrigated lands in the West. The 20,000,000 acres now irrigated provide the principal support for 12,000,000 people living in the region. The additional 10,000,000 must provide the agricultural background for all the additional millions which may some day make their homes in the West.

From the outset, Federal Reclamation projects have been established on a self-liquidating basis: That is, each project is set up in such a manner that to the best of our belief the entire sum expended in its construction will be returned to the United States, either through payments for water rights or through sale of power. More than 98 percent of all the payments which have become due from our water users have been met, and the amount repaid is almost $50,000,000 for construction alone.

Dams Serve Multiple Purpose

Many of the storage dams built by the Bureau of Reclamation serve also to withhold flood waters, to increase the low flow of streams for navigation and pollution abatement, and otherwise to provide benefits incidental to the major purpose. Last year Alamogordo Dam, being constructed on the Pecos River to provide supplemental storage for the Carlsbad Federal Reclamation project, caught and held the greatest flood which ever had visited that section of the stream. It was estimated at the time that though incomplete, Alamogordo Dam had prevented flood damages which otherwise might have aggregated more than a million dollars, a sum almost as great as the cost of the dam.

The large structures now being constructed by the Bureau of Reclamation all are multiple purpose dams. Boulder Dam on the Colorado River, Grand Coulee Dam on the Columbia River, Shasta Dam on the Sacramento River, and Seminoe Dam on the North Platte River are structures of this class. They serve to regulate important streams for irrigation and domestic water supply, but they also serve in the control of floods; in the improvement of navigation; they serve by increasing the low flow for pollution abatement, and for salt water repulsion, and they serve by the generation of hydroelectric power. These structures, because of their size, have attracted more national attention than all the rest of the work of the Bureau of Reclamation, but they by no means form the whole of this work.

To a western community dependent upon irrigation water for its livelihood, a small earthen dam, like dozens the Reclamation Bureau has built to catch the flood waters of smaller streams and to retain them for use, has an importance which is as great.

America has before it a gigantic task in the control and conservation of its waters. Much progress has been made in recent years in defining the problem, and a start has been made at the job of solving it. If we, as a Nation, are to reach our highest goal, this work must go on.

[1] Paper submitted and read before the National Rivers and Harbors Congress in session January 20–22 at the Mayflower Hotel, Washington, D. C.

Contract Awarded for Completion of GRAND COULEE DAM

SECRETARY of the Interior Harold L. Ickes announced on January 28 approval of the award of the contract for completion of Grand Coulee Dam, among the biggest of Government jobs, to a combination of contractors who bid under the name of Interior Construction Co. of Oakland, Calif., on a tender of $34,412,240.

Bids for this work, which involves placement of about 5,250,000 cubic yards of concrete in the world's most massive masonry structure, were opened by the Bureau of Reclamation December 10, 1937, at Spokane, Wash. Two tenders were received, that of the Interior Construction Co., which is a combination of 10 large contractors, and a second of $42,185,802.50 from the Pacific Constructors, Inc., of Los Angeles, Calif., a combination of eight contractors.

After careful study by the Bureau of Reclamation of the tenders, Commissioner John C. Page recommended the award, provided it was considered that the competition in the bidding was sufficient. The General Accounting Office, which was requested to review the bids, reported that it found the results of the advertisement for bids complied with the law and it did not object to the award.

The Interior Construction Co. is composed of the M. W. A. K. Co., which recently completed the foundation of Grand Coulee Dam, and the members of the firm, Six Companies, Inc., which carried out the contract for the construction of Boulder Dam, with one additional company. The contractors making up the combination which received the contract are: Silas Mason Co. of New York City, Walsh Construction Co. of Davenport, Iowa, and the Atkinson-Kier Co. of San Francisco, Calif., members of M. W. A. K. Co., and the Morrison-Knudsen Co. of Boise, Idaho, the J. F. Shea Co., Los Angeles, McDonald & Kahn, Los Angeles, Pacific Bridge Co., of San Francisco, Henry J. Kaiser Co. of Oakland, and the Utah Construction Co. of Ogden, Utah, members of Six Companies, Inc., and the General Construction Co. of Seattle, Wash.

The contractor must commence work within 30 days of notification to proceed, which will be issued by the Bureau of Reclamation as soon as the completed contract is on file, and will have 4 years to complete the work. Covered by the contract are the completion of Grand Coulee Dam to its full height of 553 feet, construction of the powerhouse on the west side of the Columbia River at the toe of the dam, and appurtenant works.

The contract which covered the foundation of Grand Coulee Dam also covered construction of the foundation for the twin powerhouses at its toe. The powerhouse on the east bank of the river will be completed later.

The new contract involves principally the manufacture of concrete and its placement in the dam, whereas the first contract covered excavation of the foundation area as well as placement of about 4,450,000 cubic yards of concrete.

Grand Coulee Dam will create a reservoir 151 miles long and will regulate the Columbia River for the control of floods, for the improvement of navigation, as well as for the purpose of providing a stored water supply to be used in the irrigation of 1,200,000 acres of land and in the generation of hydroelectric power. The power plant, when completed, will contain 18 generators each of 105,000-kilowatt capacity.

The foundation dam was begun in 1934 and has been constructed to an average height of 177 feet above the bedrock. When completed Grand Coulee Dam will contain about three times as much concrete as Boulder Dam. Its height of 553 feet will make it the second tallest in the world and it will be more than three-fourths of a mile long across the crest. In addition to placing concrete the new contract covers the placement of about 160,000,000 pounds of steel, 10,000,000 pounds of pipe and fittings, 50,000,000 pounds of gates and operating devices, 24,000,000 pounds of trashrack metal work, and 16,000,000 pounds of penstock.

The contract for completion of Grand Coulee Dam is the largest construction contract awarded by the Government since 1931, when Boulder Dam was begun. The posting of bonds totaling $7,500,000 was required of the successful bidder. Of these one was a performance bond of $5,000,000 and another was a payment bond of $2,500,000 to assure payment of labor and material bills.

The Government will purchase and provide all the materials which will become parts of the dam, such as cement, steel, and machinery. The contractor will provide, however, the sand and gravel, which will be obtained from a deposit on the east bank of the Columbia River Canyon near the dam.

• STEEL BARS •

A CONTRACT covering 1,700 tons of deformed reinforcing bars for the Grand Coulee Dam, under construction by the Bureau of Reclamation on the Columbia River in Washington, was awarded on January 28, 1938, by Secretary of the Interior Harold L. Ickes to the Columbia Steel Co. of Denver, Colo., on its bid of $88,887.16.

Bids were opened by the Denver Reclamation office December 27, 1937, and 13 proposals were received. The successful bid, after discounts and allowances, was determined to be lowest by more than $1,000.

The steel will be used in the work expected to begin shortly of raising the dam to its full height of 553 feet.

Menacing Morning Glory

(*Concluded from page 32*)

proved effective for small areas, one must watch carefully to prevent the vines from growing out between the layers. The principal involved in smothering the plant with such materials is the same as in cultivation—namely, to prevent the formation of green leaves, thus forcing the plant to use up its reserve material in developing new shoots. Efforts to smother morning glory with organic substances, such as straw and manure, have uniformly failed.

Of the crops used, a vigorous stand of alfalfa, well watered, is best and will greatly reduce, though not completely eradicate, the morning glory. Experience shows that if the field is kept in alfalfa 4 or 5 years, morning glory will be so reduced in vigor that other crops can be grown for several years before the weed renders them unprofitable. The use of alfalfa, followed by cultivation or by chemical treatment, will in the long run probably prove the most effective means of control.

Flooding

In morning glory control, flooding has been used with variable results. Where water is plentiful and cheap, it would warrant trial. The infestations should be diked and submerged for 60 to 90 days in midsummer. Where seeds are abundant in the soil, the area may be allowed to dry until germination starts and then reflooded for 2 or 3 weeks. Best results from flooding are apparently obtained on light sandy soils.

The attempts to eradicate morning glory with chemical herbicides have met with varying success because of insufficient knowledge as to the method of absorption of the chemical by the plant, and of the proper physiological and environmental conditions for absorption. Even yet, knowledge on some of these points is meager; but certain conditions of growth and environment are known to be necessary for success.

The chemicals most widely used and most likely to succeed on morning glory are carbon disulphide, arsenicals, and chlorates.

Though the use of herbicides offers a promising means of eradicating morning glory, as stated before good results cannot be obtained without due attention to the stage of growth, the condition of the plants, the nature of the soil, and the environmental conditions at the time the spray is applied. No single application of any chemical is likely to eradicate morning glory completely.—*Pacific Rural Press.*

Commissioner Page addressing radio audience at Spokane, Wash., over a Nation-wide hook-up. His address was heard distinctly on the eastern coast. Construction Engineer F. A. Banks is seated at Mr. Page's left.

• ELLENSBURG •

THE Central Washington College of Education at Ellensburg, Yakima project, during the past year completed the construction of two new buildings on the campus. An auditorium, with a seating capacity of 1,000, is equipped with the latest facilities for drama, speech, and music.

The second building is a $70,000 addition to the college gymnasium. This addition provides a larger playing floor and adequate dressing and shower rooms for both men and women students.—*Spokane Spokesman-Review.*

• GRAPEFRUIT JUICE •

COMMERCIAL operation of Yuma's newest industry, the juicing and canning plant of the Yuma Mesa Fruit Growers' Association, started on December 23 last with standing orders for almost half of a normal season's output. Commercial operation followed a brief test-run made on the day previous. Electrically operated, with the grapefruit untouched by hand in the entire juicing and canning process, and with the latest type stainless steel machines and equipment, the local plant is most modern and complete in all respects. Its normal capacity is 1,000 cases of grapefruit juice per day, with the season's total output estimated at between 75,000 and 100,000 cases.

• GRAND COULEE DAM •

GRAND COULEE DAM, now under construction on the Columbia Basin project, Washington, is rated as the "Eighth Wonder of the World," a dam so vast that four buildings of the size of the Capitol at Washington could be imbedded—wings, domes, and all—in its awesome concrete bastions.—*Fortune Magazine.*

Placing of Concrete in Two Large Dams

THE accompanying table gives the records made in placing concrete at the Boulder Canyon and Grand Coulee Dams with daily, monthly, and annual maximum quantities.

The contract for the Boulder Canyon Dam and power plant by the Six Companies, Inc., was completed on February 29, 1936. The last concrete in the foundation of the Grand Coulee Dam under the present contract with the M. W. A. K. Co., was placed on January 10, 1938. It will be noted that the volume of concrete is nearly the same in both dams.

Year	Concrete production (cubic yards)	
	Boulder Canyon project	Columbia Basin project
1932	363, 385	----------
1933	1, 149, 393	----------
1934	2, 563, 784	----------
1935	364, 014	21, 350
1936	57, 738	1, 858, 300
1937	3, 995	2, 621, 535
1938	----------	37, 633
Total	4, 502, 309	4, 523, 000
Monthly maximum	261, 874	377, 135
Daily maximum	10, 417	15, 672

The Boulder Dam is completed but the Grand Coulee Dam and power plant is only about one-third completed.

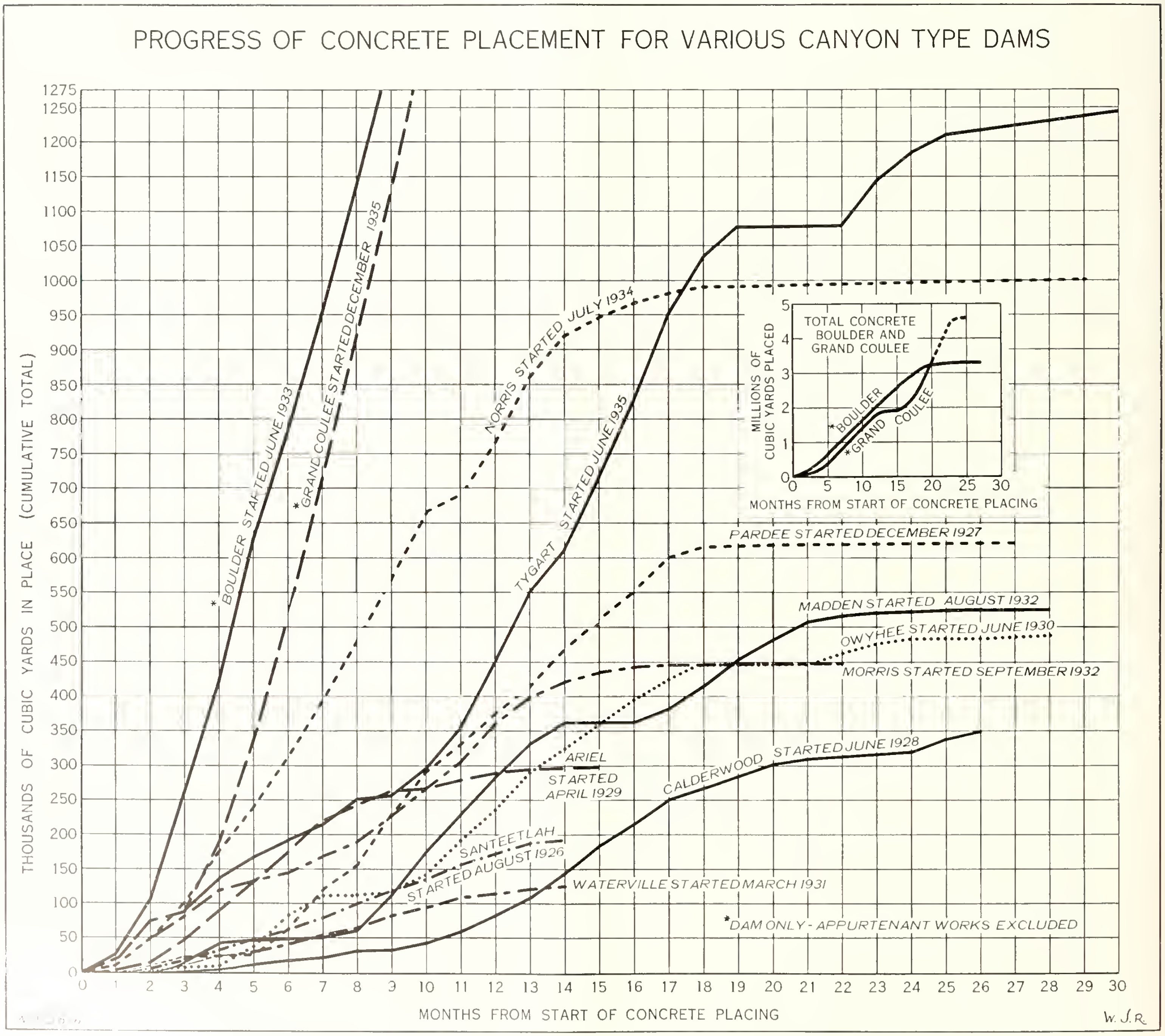
Brief Chronology, Development of Boulder Canyon Project, Growth of Demand for Water and Power in the Southwest

June 6, 1933: First concrete placed in dam.

January 7, 1934: First millionth cubic yard concrete placed in dam.

June 6, 1934: Second millionth cubic yard of concrete in dam.

(*Concluded on page 39*)



Taylor Park Dam, Uncompahgre project, Colorado, recently completed by the Bureau of Reclamation to supply a supplemental water supply for the project. Of earth-filled construction, Taylor Park Dam is 168 feet high and has created a reservoir on the Taylor River, a tributary of the Colorado, of 106,200-acre-feet capacity. Already 10,000 acre-feet are stored. The dam will begin regulation of this river next spring.

• NEW MAPS AVAILABLE •

THE Bureau of Reclamation has issued the following maps which may be obtained upon application to the Bureau, payment to be made in advance by check or money order drawn to the Bureau of Reclamation. *Postage stamps are not acceptable.*

Map No. 26400 (1937) Colorado-Big Thompson (colored), size 10½ by 25¼ inches. Price, 15 cents each.

Map No. 23300 (revised 1937) Owyhee Project, Oregon-Idaho (colored), size 10½ by 17 inches. Price, 15 cents each.

Map No. 23300–A (revised 1937), Owyhee Project, Oregon-Idaho (colored), size 20½ by 33 inches. Price, 25 cents each.

Map No. 23883 (revised 1937), Minidoka Project, Idaho (colored), size 8½ by 11 inches. Price, 10 cents each.

Map No. 23883–A (revised 1937), Minidoka Project, Idaho (colored), size 17 by 22 inches. Price, 25 cents each.

• SETTLEMENT ON GRAND VALLEY PROJECT •

THE Farm Security Administration placed farmers on 26 project units in the lower valley during the year 1937. These units comprise approximately 1,400 acres of Grand Valley project lands. New improvements have been built on all except a few of the units and where old buildings have been retained these have been put in a first-class shape.

Civilian Conservation Corps Constructs the Anita Dam—Huntley Project

By IRVING BERG, *Senior Foreman, CCC Camp BR-57, Ballantine, Mont.*

THE operation plan of the Huntley Reclamation Project, located in southern Montana, requires irrigation water for the eastern end of the project to be pumped 45 feet from the Main Canal at Ballantine to the High Line Canal, which conveys it 8 miles to a 38-foot drop to the Reservoir Line Canal, for delivery to the east end farm units. At the peak of the irrigation season an auxiliary pumping plant is required to help the main plant pump the water from the Main Canal to the High Line Canal.

It has long been evident that a reservoir for storage of water at some point on the High Line Canal would reduce the peak loads at the pumping plant and the number of days of its operation, permitting equalization of the flow to the Reservoir Line Canal. With the establishment of CCC Camp BR–57 at Ballantine, Mont., late in 1935, it became possible to undertake the construction of the necessary dam for a storage reservoir of 500 acre-feet capacity. The site selected is the location of the 38-foot drop to the Reservoir Line Canal, approximately 1 mile southeast of the Anita railroad station, which suggested the name "Anita Dam."

Construction of the Dam

Construction of the Anita Dam by enrollees from Camp BR 57 began in June 1936, with the stripping of the foundation and excavation of the cut-off trench, which were accomplished with the aid of a one-half yard dragline, tractors, and rotary scrapers. The cut-off trench, with a bottom width of 8 feet and 1 : 1 side slopes, was carried 2 feet into shale under the impervious section of the dam. A short concrete cut-off wall was placed in the lowest portion of the cut-off.

The dam, with its axis on a north-south line, has a crest length of 1,008 feet, a crest width of 20 feet, a maximum height of 36.5 feet above the original stream bed, and contains 106,000 cubic yards of rolled-earth embankment. Placing of the impervious materials in the cut-off was started in July 1936. Material for the impervious section of the dam consisted of clay, sand, and gravel which were excavated from within the reservoir area. Borrow pits were irrigated wherever it was possible, in order to obtain a more uniform moisture content and require much less addition of moisture after the materials were placed on the fill. Irrigating borrow pits permits more rapid placement of the rolled embankment and the machinery is not bogged down in the fill. More uniform compaction of the fill is also obtained by this procedure.

Placing of the rolled embankment of the dam was accomplished by one Diesel 50 horsepower tractor and 6 cubic-yard carry-all scraper; one Diesel 66-horsepower tractor and 8-cubic yard scraper; one Diesel 66-horsepower angledozer; one 35-horsepower gas tractor; one 22-horsepower gas tractor; four 1½-yard dump trucks, all operated by CCC enrollees, and a ½-cubic yard dragline.

The rolled-earth embankment was placed in approximately horizontal layers of not more than 6 inches in thickness after compaction. Care was taken in placing loads of material with the greatest amount of fines in the central upstream portion of the earth fill. In order to obtain the maximum density, compaction of the earth fill was obtained by passing over each layer of fill from 8 to 12 times with a sheepsfoot roller. The roller is made up of four 18-inch sections, 40 inches in diameter, set on a solid axle. Spacing of the feet was such that the pressure exerted on any one row of feet was 280 pounds per square inch. The 35-horsepower tractor was used with the sheeps-foot roller for the rolling operation. Compaction of earth around structures was accomplished with a gasoline explosion type tamper and a pile hammer hooked on the hoist line of the dragline.

The upstream face of the dam is faced with 6 inches of gravel and with 1 foot of dumped rock riprap for 20 feet below the crest elevation.

Concrete Structures

The outlet works for controlling the flow of water from the reservoir to the Reservoir Line Canal consist of a 2½- by 2½-foot reinforced concrete conduit, 285 feet in length, with concrete control gate shaft protruding through the upstream face of the embankment, just outside the crest of the dam. The outlet works are located on the south end of the dam and are founded entirely on shale.

A concrete spillway, located on the north abutment, is designed for a capacity of 1,500 cubic feet per second, with an additional capacity of 1,500 cubic feet per second provided in a grass spillway east of the main spillway. The concrete spillway has a crest length of 40 feet.

The approach channel from the reservoir to

Anita Dam built by the Civilian, Conservation Corps.

the spillway is 75 feet in width, and to the emergency spillway the channel narrows down to 30 feet. The spillway approach channel is also the inlet channel for the water flowing from the High Line Canal into the reservoir. A check, 75 feet in width, was constructed in the channel between the spillway and the reservoir to regulate the flow of water into the High Line Extension Steel Pipe Siphon, which carries irrigation water across the coulee below the dam to the High Line Extension Canal.

Concrete aggregates were obtained from the CCC gravel screen on the Yellowstone River. Construction of the appurtenant works required the placing of 76,000 pounds of reinforcing steel and 780 cubic yards of concrete.

Detailed plans and specifications for the construction of the Anita Dam were furnished by the Denver office, with instructions for supervising the construction. Construction of the dam has been carried on in a safe, workmanlike manner, with a minimum amount of lost-time accidents. A notable feature in the construction of the Anita Dam is that the entire project lent itself exceptionally well to enrollee labor, the enrollees carrying out all features of the work under the direction of their regular supervisory personnel.

During construction of the dam it was regularly inspected by officials of the Denver office. The field work was under the immediate supervision of Mr. E. E. Lewis, Regional Director, CCC; Mr. Daniel Behan, Superintendent of Camp BR-57, and the author.

The CCC enrollees, averaging around 18 years of age, with very little or no experience in construction work, generally adapted themselves quite readily to construction work. Work projects of the type carried on at Bureau of Reclamation camps have given many enrollees a practical experience in construction work that will prove valuable to them in obtaining jobs. The fact that many of the enrollees of Camp BR-57 have availed themselves of the opportunity of CCC job training and experience is shown by their employment with contractors on earth-moving jobs using heavy equipment.

The reservoir created by the Anita Dam will be placed in service for the first time in the spring of 1938 and will remain a monument to the accomplishments of the CCC on the Huntley Project long after the camp has been terminated.

Placing of Concrete

(Concluded from page 36)

December 5, 1934: Third millionth cubic yard of concrete placed in dam.

February 1, 1935: Storage of water in reservoir begun.

May 29, 1935: Last concrete poured for dam—in slot.

September 30, 1935: President Franklin D. Roosevelt dedicated dam, during visit at site.

February 29, 1936: Six Companies completed work on dam and contract accepted.

September 11, 1936: President Franklin D. Roosevelt started generator by golden button key from Washington, D. C.

October 9, 1936: Power transmitted to Los Angeles over new line.

March 17, 1937: First power delivered to Las Vegas, Nev., line.

May 26, 1937: First flood lighting of dam.

August: 71,254 persons visited the project of whom 40,607 visited power plant.

August 16, 1937: First power delivered to Nevada-Calif. Electric Corporation system.

September 1, 1937: First power delivered to Lincoln County power district line.

December 31, 1937, 15,068,000 acre-feet storage in Lake Mead.

Power generated in 1937

	Total kilowatt-hours generated	Main generators
January	82, 345, 000	3
February	73, 062, 000	3
March	76, 114, 000	4
April	78, 426, 000	4
May	78, 880, 000	4
June	81, 832, 000	4
July	84, 309, 000	4
August	93, 262, 000	5
September	114, 342, 000	5
October	135, 450, 000	5
November	139, 434, 000	5
December	142, 712, 000	5

• *Minidoka Building Activities* •

A START has been made on the erection of the new municipal building in Rupert, Idaho, on the Minidoka project. Many other public buildings and residences have also been constructed in the town. In Burley, some 40 residences have also been or are being erected, including lodge buildings for the Elks and Odd Fellows, and Latter Day Saints Church, besides business houses and residences.

• *Sugar Plant Enlargement* •

PLANS have been announced for enlarging the beet sugar plant of the Utah-Idaho Sugar Company at Toppenish, Washington, to 1,800 tons a day capacity. The present capacity is 1,200 tons per day.

• *Shoshone's Christmas Spirit* •

SEVERAL community organizations on the Shoshone project combined their money and efforts and distributed baskets to about 50 needy families, thus bringing happiness to the homes of their less fortunate neighbors.

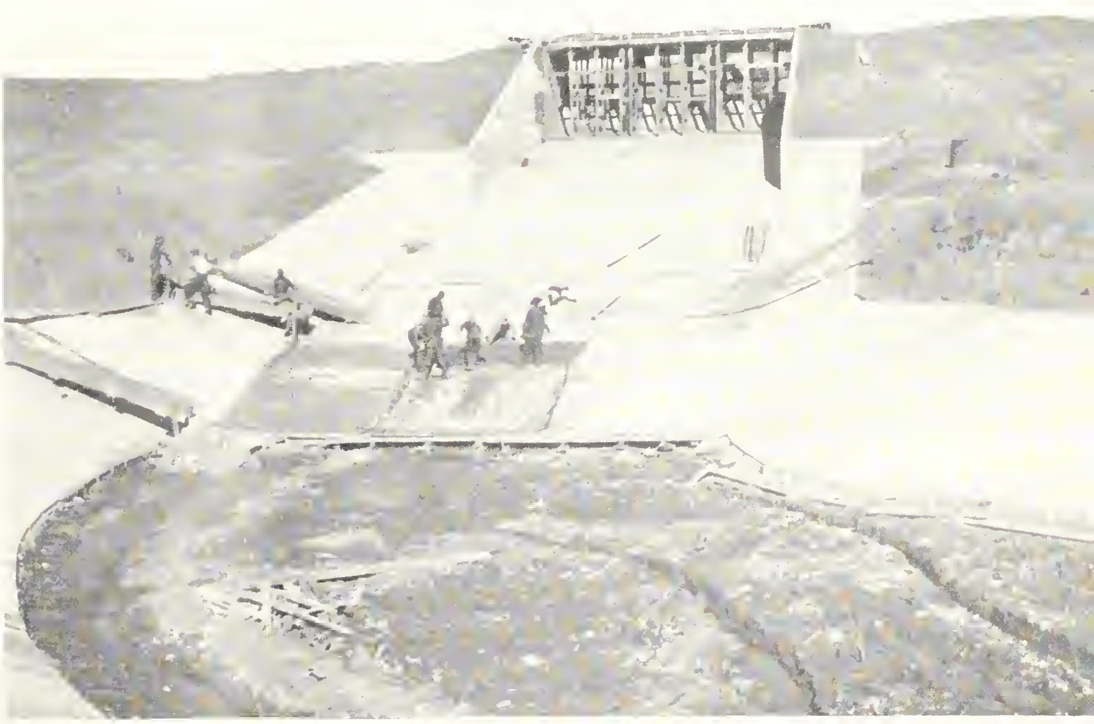
• *Stockmen's Association Formed* •

MEETING at Toppenish, Washington, late in December, stockmen formed the Yakima Valley Stockmen's Association, the purpose of which is to promote the cattle industry of the valley.

Retirement

Clarence J. Clements, engineering draftsman, Yakima project, was retired Aug. 31, 1937, from the Service on account of disability.

CCC enrollees constructing spillway for Anita Dam.



Reclamation Organization Activities

COMMISSIONER PAGE
Submits Paper to National Rivers and Harbors Congress

JOHN C. PAGE, Commissioner of Reclamation, submitted a paper on the subject "Wild Western Rivers," which was read at the annual meeting at the Mayflower Hotel in Washington, of the National Rivers and Harbors Congress on January 20. For this conference the Bureau had installed a general exhibit depicting its work in the field of construction, featuring the Grand Coulee Dam, Columbia Basin Project, Wash.

On January 20 L. N. McClellan, Chief Electric Engineer of the Bureau of Reclamation in Denver, represented the Bureau at the annual meeting in New York of the American Society of Civil Engineers, and presented a paper on the subject, "Elements of Cost," by Commissioner Page.

A digest of the former paper and the full text of the latter are given elsewhere in this issue.

Designing Engineer Savage Has Great Honor Bestowed

J. L. SAVAGE, Chief Designing Engineer of the Bureau, will serve as American vice president of the International Commission on High Dams. In a letter addressed to O. C. Merrill, Director of the Third World Power Conference, from J. Aubert, general secretary of the Commission at Paris, he states: "Allow me to tell you how much the Commission is to be congratulated at the choice of Mr. J. L. Savage as one of the officers."

Transfers

The following transfers were recently authorized by the Secretary of the Interior:

To Colorado River:

Ernest A. Moritz, construction engineer, from same position on the Parker Dam project, Parker Dam, Calif.

To All American Canal:

Donald R. Alexander, junior engineer, from the same position, Taylor Park Dam, Colo.

John S. Smith, assistant engineer, from the same position on the Humboldt project, Nev.

John J. Welsh, assistant engineer, from the Humboldt project, Nev.

To Parker Dam:

Howard P. Bunger, construction engineer, from same position on the Colorado River project, Austin, Tex.

To Gila:

Maj. O. Simons, assistant engineer, from the same position on the Truckee Storage project, Reno, Nev.

John C. Diehl, associate engineer, from the same position on the Humboldt project, Reno, Nev.

Alexander McD. Brooks Retires

ALEXANDER McD. BROOKS, purchasing agent for the Bureau of Reclamation in the Denver office, will be retired from active Government service on March 31 next. On the evening of January 12 a group of his official associates tendered Mr. and Mrs. Brooks a farewell dinner at the Olin Hotel in Denver. Mr. Brooks has long looked forward to his retirement which he will spend in activities of his own choosing. After January 13 he will be free to follow his own inclinations. The following biographical sketch has been prepared for publication:

Colonel Brooks' early life was one filled with military achievement. On November 15, 1889, at an early age, he joined the "Chaffee Light Artillery" (a battery made famous in the early annals of Colorado history), First Brigade, Colorado National Guard, and advanced in rank until he became Assistant Adjutant General of Colorado in April 1892, which position he filled with honor until mustered out in 1898, when he joined the First Colorado Infantry, U. S. Volunteers. He served this unit as First Lieutenant, Captain, and Adjutant, seeing active service during the Spanish-American War.

After the capture of Manila, he was promoted to the rank of Captain, and assigned to the staff of Brigadier General Irving Hale. When historic Fort San Antonio de Abad had been shelled into submission by Dewey's fleet, and the First Colorado Infantry assailed the walls of that fortification, Colonel Brooks was the first to raise Old Glory over the heights of Old Manila. For this exploit, Colonel Brooks was later awarded a citation, with silver star, by the War Department. He was appointed Lieutenant Colonel, First Infantry, Colorado National Guard, June 1, 1900, from which assignment he resigned in August 1901.

From November 1902 until September 1912, Colonel Brooks served as manager of J. M. O'Rourke & Co., the contractors for the construction of the Galveston sea wall, and the Roosevelt Dam in Arizona.

Colonel Brooks entered the service of the Bureau of Reclamation on September 30, 1912, at the headquarters office of the Rio Grande project in El Paso, Tex. In February 1913, he was made purchasing agent at Elephant Butte Dam, where he later served as chief clerk until his transfer to the Denver office in February 1916. In the Denver office Colonel Brooks was made purchasing agent and was responsible for the details of purchasing materials, supplies, and equipment totaling hundreds of millions of dollars in cost, for use on all of the far-flung projects completed and under construction by the Bureau since that date. During 1922 and 1923, Colonel Brooks served as President of the Denver Purchasing Agents' Association.

Vacation Time

Three score and ten his birthdays stand.
  So into another hand
Will go the post of high command
  Which he has held for years.

Then let us say, in brief review
  The things he's done, we'd like to do
And though his work with us is through,
  This is no time for tears.

His working days, 'tis true, are done,
  So down with work and up with fun.
Retirement days have now begun.
  Say au revoir with cheers.

Let's give a loud and glad hurrah!
  For Colonel Brooks and Mardi Gras.
May peace and joy, without a flaw,
  Abide with him for years.

U. S. GOVERNMENT PRINTING OFFICE 1938

ADMINISTRATIVE ORGANIZATION OF THE BUREAU OF RECLAMATION

HAROLD L. ICKES, SECRETARY OF THE INTERIOR

——— ———, FIRST ASSISTANT SECRETARY, in charge of reclamation

John C. Page, Commissioner

Roy B. Williams, Assistant Commissioner

J. Kennard Cheadle, Chief Counsel and Assistant to Commissioner; Miss Mae A. Schnurr, Chief, Division of Public Relations; George O. Sanford, General Supervisor of Operation and Maintenance; D. S. Stuver, Asst. Gen. Supr.; Wesley R. Nelson, Chief, Engineering Division; P. I. Taylor, Assistant Chief; A. R. Golzé, Supervising Engineer, C. C. C. Division; William F. Kubach, Chief Accountant; Charles N. McCulloch, Chief Clerk; Jesse W. Myer, Chief, Mails and Files Division; Miss Mary E. Gallagher, Secretary to the Commissioner

Denver, Colo., United States Customhouse

R. F. Walter, Chief Eng.; S. O. Harper, Asst. Chief Eng.; J. L. Savage, Chief Designing Eng.; W. H. Nalder, Asst. Chief Designing Eng.; L. N. McClellan, Chief Electrical Eng.; Kenneth B. Keener, Senior Engineer, Dams; H. R. McBirney, Senior Engineer, Canals; E. B. Debler, Hydraulic Eng.; I. E. Houk, Senior Engineer, Technical Studies; Spencer L. Baird, District Counsel; L. R. Smith, Chief Clerk; Harry Caden, Fiscal Agent; A. McD. Brooks, Purchasing Agent; C. A. Lyman and Henry W. Johnson, Field Representatives; L. S. Davis, Engineer, C. C. C. Division

Projects under construction or operated in whole or in part by the Bureau of Reclamation

Project	Office	Official in charge		Chief clerk	District counsel	
		Name	Title		Name	Address
All-American Canal [1]	Yuma, Ariz	Leo J. Foster	Constr. engr	J. C. Thrailkill	R. J. Coffey	Los Angeles, Calif.
Belle Fourche	Newell, S. Dak	F. C. Youngblutt	Superintendent	J. P. Siebeneicher	W. J. Burke	Billings, Mont.
Boise	Boise, Idaho	R. J. Newell	Constr engr	Robert B. Smith	B. E. Stoutemyer	Portland, Oreg.
Boulder Dam and power plant [1]	Boulder City, Nev	Ralph Lowry	do	Gail H. Baird	R. J. Coffey	Los Angeles, Calif.
Buffalo Rapids	Glendive, Mont	Paul A Jones	do	Edwin M. Bean	W. J. Burke	Billings, Mont.
Burnt River	Unity, Oreg	Clyde H. Spencer	do		B. E. Stoutemyer	Portland, Oreg.
Carlsbad	Carlsbad, N. Mex	L. E. Foster	Superintendent	E. W. Shepard	H. J. S. Devries	El Paso, Tex.
Central Valley	Sacramento, Calif	W. R. Young	Constr. engr	E. R. Mills	R. J. Coffey	Los Angeles, Calif
Colorado-Big Thompson	Denver, Colo				J. R. Alexander	Salt Lake City, Utah
Colorado River	Austin, Tex	Ernest A. Moritz	Constr engr	William F. Sha	H. J. S. Devries	El Paso, Tex.
Columbia Basin	Coulee Dam, Wash	F. A. Banks	do	C. B. Funk	B. E. Stoutemyer	Portland, Oreg.
Gila	Yuma, Ariz	Leo J. Foster	Constr. engr		R. J. Coffey	Los Angeles, Calif.
Grand Valley	Grand Junction, Colo	W. J. Chiesman	Superintendent	Emil T. Ficenec	J. R. Alexander	Salt Lake City, Utah.
Humboldt	Lovelock, Nev	Stanley R. Marean	Resideut engr [2]	George B. Snow	do	Do.
Kendrick	Casper, Wyo	H. W. Bashore	Constr. engr	C. M. Voyen	W. J. Burke	Billings, Mont.
Klamath	Klamath Falls, Oreg	B. E. Hayden	Superintendent	W. I. Tingley	B. E. Stoutemyer	Portland, Oreg.
Milk River	Malta, Mont	H. H. Johnson	do	E. E. Chabot	W. J. Burke	Billings, Mont.
Fresno Dam	Havre, Mont	H. V. Hubbell	Constr. engr	do	do	Do.
Minidoka	Burley, Idaho	Dana Templin	Superintendent	G. C. Patterson	B. E. Stoutemyer	Portland, Oreg.
Moon Lake	Duchesne, Utah	E. J. Westerhouse	Constr. engr	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
North Platte	Guernsey, Wyo	C. F. Gleason	Supt. of power	A. T. Stimpfig	W. J. Burke	Billings, Mont.
Orland	Orland, Calif	D. L. Carmody	Superintendent	W. D. Funk	R. J. Coffey	Los Angeles, Calif
Owyhee	Boise, Idaho	R. J. Newell	Constr. engr	Robert B. Smith	B. E. Stoutemyer	Portland, Oreg.
Parker Dam	Parker Dam, Calif	Howard P. Bunger	do	George W. Lyle	R. J. Coffey	Los Angeles, Calif.
Pine River	Durango, Colo	Charles A. Burns	do	John S. Martin	J. R. Alexander	Salt Lake City, Utah.
Provo River	Salt Lake City, Utah	E. O. Larson	Engineer	Francis J. Farrell	do	Do.
Rio Grande	El Paso, Tex	L. R. Fiock	Superintendent	H. H. Berrybill	H. J. S. Devries	El Paso, Tex.
Caballo Dam	Caballo, N. Mex	S. F. Crecelius	Constr. engr	do	do	Do.
Riverton	Riverton, Wyo	H. D. Comstock	Superintendent	C. B. Wentzel	W. J. Burke	Billings, Mont.
Bull Lake Dam	do	Arthur P. Smyth	Resident engr		do	Do.
Salt River	Phoenix, Ariz	E. C. Koppen	Constr. engr	Edgar A. Peek	R. J. Coffey	Los Angeles, Calif.
Sanpete	Salt Lake City, Utah	E. O. Larson	Engineer	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
Shoshone	Powell, Wyo	L. J. Windle	Superintendent [2]	L. J. Windle [2]	W. J. Burke	Billings, Mout.
Heart Mountain division	Cody, Wyo	Walter F. Kemp	Constr. engr	do	do	Do.
Sun River, Greenfields division	Fairfield, Mont	A. W. Walker	Superintendent		do	Do.
Truckee River Storage	Reno, Nev	Charles S. Hale	Constr. engr	George B. Snow	J. R. Alexander	Salt Lake City, Utah.
Umatilla (McKay Dam)	Peudleton, Oreg	C. L. Tice	Reservoir supt		B. E. Stoutemyer	Portland, Oreg.
Uncompahgre: Repairs to canals	Montrose, Colo	C. B. Elliott	Constr. engr	Ewalt P. Anderson	J. R. Alexander	Salt Lake City, Utah.
Upper Snake River Storage [3]	Ashton, Idaho	H. A. Parker	do	Emmanuel V. Hillius	B. E. Stoutemyer	Portland, Oreg.
Vale	Vale, Oreg	C. C. Ketchum	Superintendent		do	Do.
Yakima	Yakima, Wash	J. S. Moore	do	Philo M. Wheeler	do	Do.
Roza division	do	Charles E. Crownover	Constr engr	Alex S. Harker	do	Do.
Yuma	Yuma, Ariz	R C E Weber	Superintendent	Noble O. Anderson	R. J. Coffey	Los Angeles, Calif.

[1] Boulder Canyon. [2] Acting. [3] Island Park and Grassy Lake Dams.

Projects or divisions of projects of Bureau of Reclamation operated by water users

Project	Organization	Office	Operating official		Secretary	
			Name	Title	Name	Address
Baker (Thief Valley division) [1]	Lower Powder River irrigation district	Baker, Oreg	A. J. Ritter	President	F. A. Phillips	Keating.
Bitter Root [4]	Bitter Root irrigation district	Hamilton, Mont	N. W. Bliudauer	Manager	Elsie H. Wagner	Hamilton.
Boise [1]	Board of Control	Boise, Idaho	Wm. H. Tuller	Project manager	F. J. Hanagan	Boise.
Do	Black Canyon irrigation district	Notus, Idaho	W. H. Jordan	Superintendent	L. M. Watson	Caldwell.
Frenchtown	Frenchtown irrigation district	Frenchtown, Mont			Ralpb P. Scheffer	Huson
Grand Valley, Orcbard Mesa [3]	Orchard Mesa irrigation district	Grand Jctn., Colo	C. W. Tharp	Superintendent	C. J. McCormich	Grand Jctn.
Huntley [4]	Huntley irrigation district	Ballantine, Mont	E. E. Lewis	Manager	H. S. Elliott	Ballantine.
Hyrum [3]	South Cache W. U. A	Hyrum, Utah	B. L. Mendenhall	Superintendent	Harry C. Parker	Logan.
Klamath, Langell Valley [1]	Langell Valley irrigation district	Bonanza, Oreg	Chas. A. Revell	Manager	Chas. A. Revell	Bonanza.
Klamatb, Horsefly [1]	Horsefly irrigation district	do	Henry Schmor, Jr	President	Dorothy Eyers	Do.
Lower Yellowstone [4]	Board of Control	Sidney, Mont	Axel Persson	Manager	Axel Persson	Sidney.
Milk River: Cbinook division [4]	Alfalfa Valley irrigatiou district	Chinook, Mont	A. L. Benton	President	R. H. Clarkson	Chinook.
Minidoka: Gravity [1]	Minidoka irrigation district	Rupert, Idaho	Frank A. Ballard	Manager	O. W. Paul	Rupert.
Pumping [1]	Burley irrigation district	Burley, Idaho	Hugh L. Crawford	do	Frank O. Redfield	Burley.
Gooding [1]	Amer. Falls Reserv. Dist. No. 2	Gooding, Idaho	S. T. Baer	do	P. T. Sutphen	Gooding.
Newlands [3]	Truckee-Carson irrigation district	Fallou, Nev	W. H. Wallace	do	H. W. Emery	Fallon.
North Platte: Interstate division [4]	Pathfinder irrigation district	Mitchell, Nebr	T. W. Parry	do	Flora K. Scbroeder	Mitchell.
Fort Laramie division [4]	Gering-Fort Laramie irrigation district	Gering, Nebr	W. O. Fleenor	Superintendeut	C. G. Klingman	Gering.
Do [4]	Goshen irrigation district	Torrington, Wyo	Bert L. Adams	do	Mary E. Harrach	Torrington.
Northport division [4]	Northport irrigation district	Northport, Nebr	Mark Iddings	do	Mabel J. Thompson	Bridgeport.
Okanogan [1]	Okanogan irrigation district	Okanogan, Wash	Nelson D. Thorp	Manager	Nelson D. Thorp	Okanogan.
Salt Lake Basin (Echo Res.) [3]	Weber River Water Users' Assn	Ogden, Utah	D. D. Harris	do	D. D. Harris	Layton
Salt River [2]	Salt River Valley W. U. A	Phoeuix, Ariz	H. J. Lawson	Superintendent	F. C. Henshaw	Phoenix.
Shoshone: Garland division [4]	Shoshone irrigation district	Powell, Wyo	M. P. McLaughlin	Irri. superintendent	Geo. W. Atkins	Powell.
Frannie division [4]	Deaver irrigation district	Deaver, Wyo	Floyd Lucas	Superintendent	Lee N. Richards	Deaver.
Strawberry Valley [3]	Strawberry Water Users' Assn	Payson, Utah	S. W. Grotegut	Manager	E. G. Breeze	Payson.
Sun River: Fort Shaw division [4]	Fort Shaw irrigation district	Fort Shaw, Mont	E. J. Gregory	do	E. J. Gregory	Fort Shaw
Greenfields division [4]	Greenfields irrigation district	Fairfield, Mont	A. W. Walker	do	H. P. Wangen	Fairfield.
Umatilla: East division [1]	Hermiston irrigation district	Hermiston, Oreg	E. D. Martin	do	Enos D. Martin	Hermiston.
West division [1]	West Extension irrigation district	Irrigon, Oreg	A. C. Houghton	do	A. C. Houghton	Irrigon.
Uncompahgre [3]	Uncompahgre Valley W. U. A	Montrose, Colo	Jesse R. Tompson	Acting superintendeut	J. Frank Anderson	Montrose.
Yakima, Kittitas division [1]	Kittitas reclamation district	Ellensburg, Wash	V. W. Russell	Manager	G. L. Sterling	Ellensburg.

[1] B. E. Stoutemyer, district counsel, Portland, Oreg.
[2] R. J. Coffey, district counsel, Los Angeles, Calif.
[3] J. R. Alexander, district counsel, Salt Lake City, Utah.
[4] W. J. Burke, district counsel, Billings, Mont.

Important investigations in progress

Project	Office	In charge of—	Title
Colorado River Basin, sec. 15	Denver, Colo	P. J. Preston	Senior engineer.
Boise-Weiser-Payette	Boise, Idabo	Lester C. Walker	Engineer.
Buford-Trenton	Denver, Colo	Wm. G. Sloan	Do.
Kings River-Pine Flat	Fresno, Calif	John R. Iakisch	Constr. engineer.
Western Slope (Colo.)	Denver, Colo	Frank C. Merriell	Engineer.
Black Hills	do	R. E. Kennedy	Assistant engineer.
Eastern Slope (Colo.)	do	A. N. Thompson	Engineer.
Salt Lake Basin	Salt Lake City, Utah	E. O. Larson	Do.
Grande Ronde	La Grande, Oreg	C. C. Fisher	Do.

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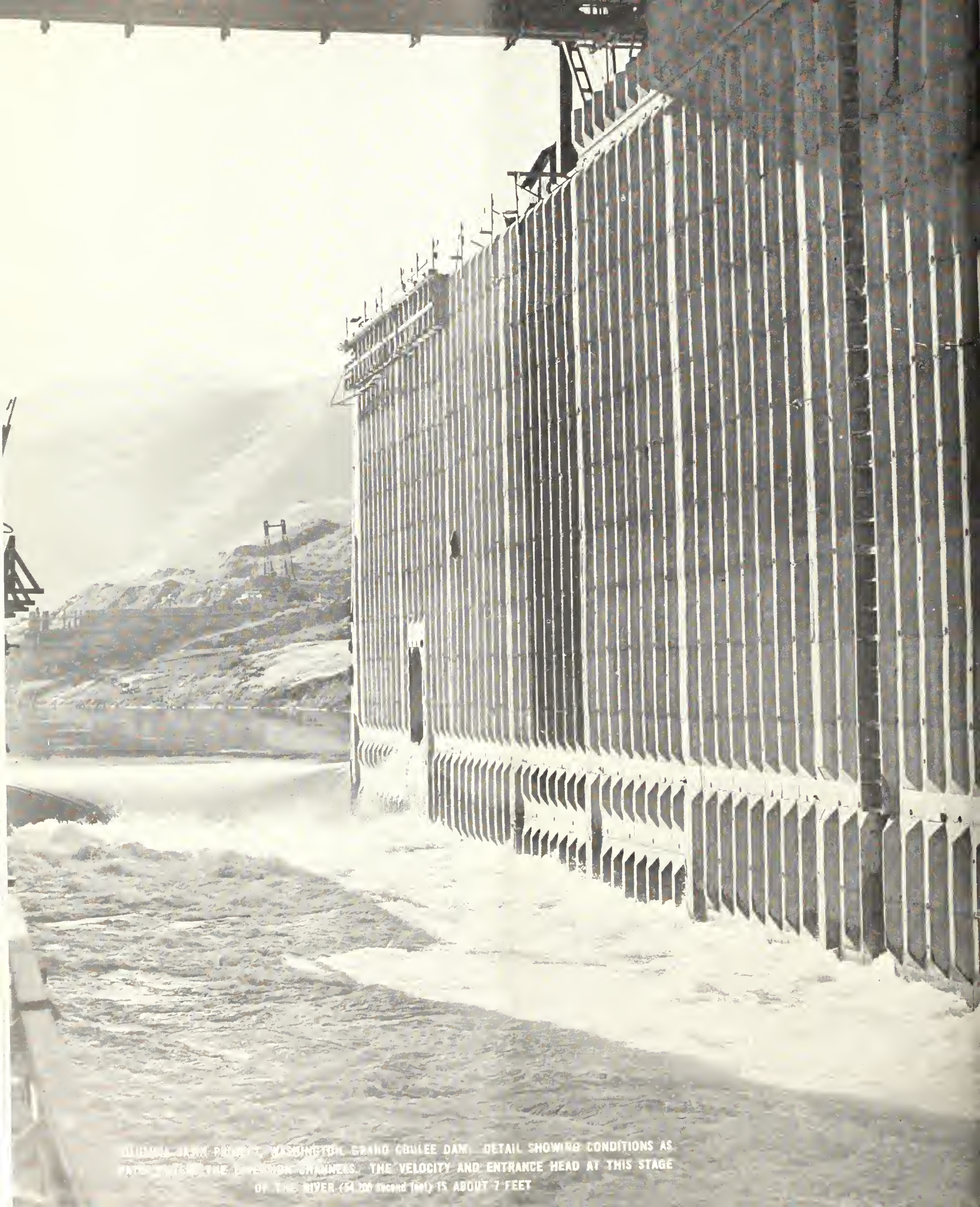


COLUMBIA BASIN PROJECT, WASHINGTON. GRAND COULEE DAM. DETAIL SHOWING CONDITIONS AS [illegible] THE DIVERSION CHANNELS. THE VELOCITY AND ENTRANCE HEAD AT THIS STAGE OF THE RIVER (54 200 second feet) IS ABOUT 7 FEET

THE RECLAMATION ERA

MARCH 1938

PARKER DAM ON THE COLORADO RIVER

REPAYMENT COMMISSION COMPLETES INVESTIGATIONS

THE REPAYMENT COMMISSION appointed by the Secretary of the Interior under the Act of August 21, 1937, completed its field investigations of the United States and Indian irrigation projects on January 26, 1938, after a trip of more than 10,500 miles by automobile through the 15 Western States, where were held 72 formal hearings with water users and 30 important conferences with State officials and representatives of the State Agricultural Colleges.

The first duty of the Commission upon its return to Denver was to give consideration to projects deserving some relief in the payment of construction charges becoming due in 1937. There were 10 projects or divisions of projects where relief was recommended and approved by the Secretary.

The next important step confronting the Commission has been the preparation of the report to be submitted to the Congress prescribing a method for determining future annual construction charges. The Commission has received a large amount of supplemental information from the water users' organizations which was found very helpful in preparing its report and recommendations to Congress. In addition to this report the Commission is considering also the economic situation on the projects and will submit a separate report to the Secretary of the Interior describing certain conditions brought out at the hearings, upon the basis of which suggestions will be made covering such features as in the opinion of the Commission should be remedied.

DR. CHARLES A. LORY,
Chairman, Repayment Commission.

PRICE ONE DOLLAR A YEAR

THE RECLAMATION ERA

VOLUME 28 • MARCH 1938 • NUMBER 3

Relation of Western Reclamation to National Progress

By HON. CARL HAYDEN, *United States Senator from Arizona*[1]

ON the face of things it may seem odd for one who comes from a State where there are dry rivers and no harbors to address the members of such an organization as is here assembled. But one does not have to think very long to arrive at the conclusion that there is a very real community of interest between those of you who at times have too much water and those of us who at other times have too little water.

Water is, after all, the principal subject of discussion in both the overarid and the overhumid sections of the United States. Whether we suffer from wetness or from dryness, the primary demand in each region is that the flow of streams be controlled and equated. Having that identical object in mind, we do have a common purpose and can be helpful to each other.

Whenever distress occurs in any part of the United States, somebody promptly says, "Congress ought to pass a law." If mere words in the statute books would cure our troubles, I am sure you would all join me in supporting a bill to exchange a million acres of desert land in Arizona, where the average annual rainfall is 3 inches, for a billion gallons of floodwater each year out of the Mississippi River below Memphis.

But the problem cannot be solved under the Capitol dome in such an easy manner. It can only be approached in detail in every region with the best engineering advice obtainable and a full realization that there must be a sound and economical expenditure of public funds. That is the approach which Congress has actually used in the past.

As one who during a service of over 25 years in Washington has supported each and every act for the improvement of rivers and harbors throughout the entire country, as one who during the same period has been intimately associated with all legislation enacted for the reclamation of arid lands, I can certify that both with respect to flood control in the East and in the Mississippi Valley, and with respect to irrigation in the West, real and substantial progress has been made and even larger benefits can be had by a continuation of the same policy of congressional enactments.

This Nation of ours has become so closely knitted together by quick communications that an injury to any part of it does not fail to injure the whole of it. It is equally true that any economic benefit which accrues to any State or region is promptly shared by the entire United States. We therefore each serve our own best interests when we increase the prosperity and well-being of Americans everywhere. On this principle the expansion of irrigation in the arid West has served the Nation by providing a stable and ever-increasing domestic market for the products of agriculture, industry, and business in the older-settled and humid areas of the United States.

From 1860 up to 1904, the year when some of you gentlemen here were organizing the National Rivers and Harbors Congress, individuals, partnerships, and cooperative associations invested private funds to the extent of $288,000,000 in irrigation projects throughout the West. This money was used for small diversion dams, canals, and ditches along hundreds of streams throughout the western half of the United States, so that the normal flow of those streams could be diverted from their channels and spread over dry but fertile valley lands for the production of winter feed for livestock in the range areas, and to grow a part of the foodstuffs for an increasing Pacific coast population.

Passage of Federal Reclamation Act

In 1902, under the inspiration of President Theodore Roosevelt, the Congress passed the Federal Reclamation Act, which provided that a portion of the revenues accruing to the Federal Government from the sale of public lands and other natural resources of the West would be paid into a revolving fund, to be used in reclaiming arid and semiarid lands by irrigation, and to be repaid by the settlers on such lands over a period of years without interest.

This legislation, assuring as it did the continued interest of the Federal Government, stimulated the investment of further private capital in reclamation projects, so that in the 4 years from 1905 to 1909 nearly a quarter of a billion dollars more went into western irrigation projects, and only $40,000,000 of that sum was spent by the Federal Government. And today, after 75 years of western irrigation, with an investment of over $1,100,000,000, of which $800,000,000 is private capital and about $310,000,000 from Federal funds, the West has made only about 1½ percent of its total land area tillable by irrigation.

We have irrigated to date with all of these expenditures only 19,500,000 acres of land, an area considerably smaller than one-half of the State of Missouri. Already approximately two-thirds of all of the available water in the West has been put to beneficial use, so that our ultimate irrigated acreage cannot reasonably add more than another eight or ten million acres.

There was a time when the people of the humid area looked upon western irrigation as competitive to the agricultural crops grown in the East and Middle West. I do not believe that much of that sentiment now exists, because only a very few of the great national surplus crops are grown at all on irrigated land, and of those that are grown practically none is produced in sufficient quantities to supply the local western demand.

Over and above what may be produced locally, the 11 Western States which constitute the original reclamation area, buy each

[1] Address delivered before the Thirty-third Annual Meeting of the National Rivers and Harbors Congress at Washington, D. C., January 21, 1938.

year from the Midwest, South, and East $120,000,000 of corn, hog and pork products; more than $97,000,000 of cotton, cottonseed, and textiles; $90,000,000 of tobacco and tobacco products; nearly $15,000,000 of hard wheat flour and processed cereals; $189,000,000 of automobiles and motor supplies; and scores of other commodities which are grown and produced in the other sections of the country. A large proportion of what is grown on western irrigated land would have to be imported into this country were it not grown by irrigation. About 75 percent of our acreage goes into the production of winter feed for range herds; the remaining fourth is devoted largely to the production of citrus and other fruits, winter and off-season vegetables, and foodstuffs for local western consumption.

The truth is that the West can never be agriculturally self-sufficient. We never can hope to provide more than a small fraction of the food and fiber which we consume. The West will continue to supply the Midwest, South, and East with the products of our vast range lands, our mines, and forests, in exchange for the products of the Corn, Cotton, and Tobacco Belts, and of the industrial cities everywhere.

Flood Control Through Reclamation

There is one other field of cooperation that I would like to mention, and that is the accomplishment of substantial measures of flood control through reclamation. The most striking example which can be cited is Boulder Dam, which has removed all danger from floods in the lower basin of the Colorado River.

Since American occupation of that area, the Imperial Valley has twice been threatened by the diversion of the entire flood flow of that stream into the Salton Sea, but its farm lands and towns are now no longer menaced. The heavy expense of repairing the breaks in the Colorado River levees will never again be incurred. Nor will it be necessary to again go into a foreign country to do the work. The Palo Verde Valley in California, which has more than once been inundated, is now safe, and the same is true of the Yuma reclamation project. It is no longer necessary to include the cost of expensive levees in the plans for irrigating 100,000 acres of land to be occupied by Indian farmers near Parker, Ariz.

The fly in the ointment, however, is that our Mexican neighbors, without any cost to themselves, have likewise had the danger from flood damage removed from at least three-quarters of a million acres of land which the nationalistic government of that republic is proceeding to colonize under its very aggressive agrarian policy. This intense activity by the Mexican authorities in Baja California emphasizes the importance of the prompt initiation and construction of all feasible irrigation projects in every State of the Colorado River Basin whether it be in Wyoming, Colorado, Utah, and New Mexico or in Arizona, Nevada, and California. Our Government must not fail to promptly make good the declaration in the Boulder Dam Act that the flood waters impounded by that great structure are to be used for irrigation and domestic uses entirely within the United States.

The Central Valley project in California is primarily designed to regulate the flow of the San Joaquin and Sacramento Rivers upon which floods have been of frequent occurrence and have done heavy damage. The waters which are now an ever-recurring menace will be spread over a great interior valley for a distance of 400 miles north and south. A danger to thousands will be translated into a benefit to many more thousands of people; to some by making adequate their water supply for irrigation and to others by preventing the intrusion of sea water, the salts of which now threaten to destroy the fertility of a half million acres.

The Grand Coulee Dam on the Columbia, which is the Nation's second largest river, will also serve a high purpose in controlling floods and improving navigation. What is true there is likewise true of practically every other dam built to conserve the flood flow of any other stream in the arid region. As examples, the Conchas Dam, in New Mexico, will reduce the floods of the Arkansas River, and the Seminoe Dam, which is likewise under construction, will mitigate floods on the North Platte.

I am fully aware that headwater reservoirs can never completely solve the flood-control problem on many of our larger streams and that levees on their lower reaches will always be required. Nevertheless, such dams do help to some extent, and the more there are of them the better, particularly when they are constructed under a plan whereby so large a part of the cost of building them is reimbursed to the Federal Government either through the sale of hydroelectric power or by charges collected from those who irrigate their lands with the water which otherwise would increase the peak of floods.

Importance of Water

To summarize what I have said, it must always be remembered that water is life in the arid and semiarid States of the West. Without water, we have but desert, plains, and mountains. But water, conserved and put to beneficial use, creates a western civilization; maintains local governments, transcontinental highways, and railways; opens up a national storehouse of mine and forest products; brings into being new wealth and a new and permanent domestic market.

Private capital and initiative have developed all the irrigation projects which it is feasible for private enterprise to undertake; the remaining waters are in navigable or interstate streams, making their development and use clearly a Federal undertaking. The Federal Government can spend a half billion dollars more on western reclamation before it will have equaled the private investments, totaling $800,000,000. Any Federal land and water conservation and development program undertaken by this Government on an economical scale should anticipate approximately $50,000,000 per year for such purposes.

President Franklin Roosevelt has many times evidenced his sound understanding and intense interest in reclamation and flood control. Thirty-seven years ago his predecessor, Theodore Roosevelt, sent this message to Congress:

"It is as right for the National Government to make the streams and rivers of the arid region useful by irrigation works, for water storage, as to make useful rivers and harbors of the humid region by engineering works of another kind.

"The reclamation and settlement of the arid lands will enrich every portion of our country."

The truth of this statement by Theodore Roosevelt is today recognized by all informed men. That you are recognizing its truth and force is evidenced by the prominence which your program committee has given to the subject of irrigation, and on behalf of the Western States I thank you and express the hope that in the future the National Rivers and Harbors Congress will treat irrigation, flood control, and river and harbor improvement work as all a part of the same national program.

• SPECIAL CEMENTS •

A VERY comprehensive report on special cements for mass concrete was prepared by J. L. Savage, chief designing engineer of the Bureau of Reclamation, for consideration of the Second Congress of the International Commission on Large Dams, World Power Conference held in Washington, D. C. in 1936.

This printed report of 230 pages, contains numerous illustrations, charts, and tables. Copies may be obtained from the Bureau of Reclamation at Washington, D. C., or Denver, Colo., at 75 cents each, payable in advance by check or money order drawn to the Bureau of Reclamation.

• DAIRY PRODUCTS •

FIGURES recently compiled by dairy products operators in the Yakima Valley show a return of $1,804,320 from dairy products during 1937, as compared with receipts of $1,626,500 in 1936. The greater income in 1937 was due to higher prices on some products, a slight increase in butter production, larger consumption of bottled milk, and a substantial increase in cheese manufacture.

NOTES FOR CONTRACTORS

Specifications No.	Project	Bids opened	Work or material	Low bidder: Name	Low bidder: Address	Bid	Terms	Contract awarded
764	Columbia Basin, Wash	1938 Jan. 14	Gate frame and track assemblies for outlet works and penstocks, Grand Coulee Dam.	Koppers Co. (Bartlett-Hayward Division).	Baltimore, Md	$468,000.00	F. o. b. Baltimore, discount ½ percent	1938 Feb. 4
756	Boulder Canyon, Ariz. Nev.	1937 Dec. 21	Main control and distribution switchboards for units A-6 and A-7, Boulder power plant	Westinghouse Electric & Manufacturing Co.	E. Pittsburgh, Pa	54,194.00	F. o. b. Boulder City	Jan. 27
				Cutler-Hammer Co., Inc.	Milwaukee, Wis	18,812.00	F. o. b. Milwaukee	Do.
757	Columbia Basin, Wash	Dec. 10	Completion of Grand Coulee Dam, left powerhouse and foundation for pumping plant	Consolidated Builders, Inc.	Oakland, Calif	34,442,240.00		Jan. 28
760	do	1938 Jan. 6	Steel penstocks and pump inlet pipes.	Western Pipe & Steel Co.	San Francisco, Calif.	1,156,624.00	F. o. b. Boyles, Ala.; Gary, Ind., Washington Heights, Ill., Cleveland, Ohio.	Jan. 26
740	Gila, Ariz.	Jan. 10	Construction of Gila River Crossing.	Metropolitan Construction Co.	Los Angeles, Calif	337,375.50		Jan. 27
1013-D	Central Valley, Calif	Jan. 19	Trickling filter for sewage disposal plant for Shasta camp.	The Dorr Co., Inc	do	2,354.00	F. o. b. Denver, Oakland, and Los Angeles	Feb. 1
1010-D	Rio Grande, N. Mex.-Tex.	Jan. 12	One ditch-cleaning and excavating machine of the crawler-traction and endless-chain, bucket-digging-unit type	Ruth Dredger Manufacturing Corporation.	do	15,880.00	F. o. b. Los Angeles, discount ½ percent	Jan. 26
1009-D	Colorado River, Tex	Jan. 10	750,000 barrels of low-heat portland cement for Marshall Ford Dam.	Trinity Portland Cement Co.	Dallas, Tex.	1,507,500.00	F. o. b. Rutledge, discount 10 cents per barrel.	(6)
1006-D	All-American Canal, Ariz.-Calif.	Jan. 3	140,000 barrels of modified portland cement in cloth sacks, 15,000 barrels in bulk, and 750 barrels in paper sacks.	California Portland Cement Co.	Los Angeles, Calif.	[4] 269,885.00	F. o. b. Colton, Calif., sack allowance 40 cents.	Jan. 25
1007-D	Gila, Ariz	Jan. 11	55,000 barrels of modified portland cement in cloth sacks	do	do	106,150.00	do	Jan. 27
A 42,459 A	All-American Canal, Ariz.-Calif.	Jan. 4	Steel reinforcement bars, 2,070,000 pounds	Bethlehem Steel Co	Buffalo, N. Y	60,721.00	F. o. b. Knob, Calif	Jan. 27
1011-D	Shoshone-Heart Mt. Wyo.; Riverton, Wyo.; Boise-Payette, Idaho.	Jan. 21	Radial gates and hoists	Valley Iron Works	Yakima, Wash	[3] 3,559.00	F. o. b. Yakima, discount 5 percent.	Feb. 4
				Olson Manufacturing Co	Boise, Idaho	1,749.58	F. o. b. Boise	Do.
705	Pine River, Colo	1937 Dec. 15	Construction of Vallecito Dam	Martin Wunderlich Co	Jefferson City, Mo	2,115,870.00		Feb. 12
1019-D	Owyhee, Oregon-Idaho	1938 Jan. 31	Three 42-inch electrically operated gate valves for Owyhee ditch pumping plant	Koppers Co. (Western Gas Division).	Fort Wayne, Ind	1,367.00	F. o. b. Fort Wayne	Feb. 8
1021-D	Central Valley, Calif	Feb. 2	Electric ranges and water heaters for Government camp at Shasta Dam.	Malleable Iron Range Co.	Beaver Dam, Wis.	[7] 114.50	F. o. b. Redding, Calif	Feb. 11
				Rutenber Electric Co	Marion, Ind	[8] 3,877.00	F. o. b. Marion, discount 2 percent.	Do.
				Wesix Electric Heater Co	San Francisco, Calif	[9] 81.50	F. o. b. Redding, discount 1 percent.	Do.
				Westinghouse Electric & Manufacturing Co.	Denver, Colo	[10] 1,001.62	F. o. b. Mansfield, Ohio, discount 2 percent.	Do.
1014-D	Owyhee, Oregon-Idaho	Jan. 25	Earthwork, South Canal laterals, S. C. 0.1 to 5.7 and sublaterals, Succor Creek Division.	Geo. B. Henly Construction Co.	Ontario, Oreg	16,025.00		Feb. 16
1016-D	do	Jan. 27	Structures, South Canal laterals, S. C. 13.8 to 23.3 and sublaterals, Succor Creek Division	Henry L. Horn	Caldwell, Idaho	23,315.70		Do.
762	Riverton, Wyo	1937 Dec. 28	Earthwork and structures for pilot laterals.	Woodward Construction Co.	Rock Springs, Wyo	69,897.00		Jan. 24
763	Kendrick, Wyo	1938 Jan. 3	3 motor-driven gate hoists for Seminoe spillway gates	Foote Bros. Gear & Machine Corporation	Chicago, Ill	11,637.00		Do.
1004-D	Gila, Ariz	Jan. 5	8 motor-driven, double-stem gate hoists for Gila Valley Canal diversion gates.	Hesse-Ersted Iron Works	Portland, Oreg	[5] 14,500.00		Do.
1008-D	Kendrick, Wyo	Jan. 1	210,000 barrels of modified portland cement in bulk for Seminoe Dam	Monolith Portland Midwest Co.	Denver, Colo	407,400.00	F. o. b. Laramie, Wyo., discount 10 percent.	Do.
1012-D	Yuma, Ariz., Rio Grande, N. Mex.	Jan. 17	2 top-seal radial gates for Siphon Drop power plant and 2 for Leasburg Canal sluiceway	General Iron and Steel Works.	Portland, Oreg	2,561.00	F. o. b. Portland	Jan. 21
759	Kendrick, Wyo	Jan. 31	Turbine, governor, and generator for third unit, Seminoe power plant.	The Pelton Water Wheel Co.	San Francisco, Calif	64,851.00	F. o. b. San Francisco	Feb. 18
				do	do	11,015.00	F. o. b. Rockford, Ill.	Do.
				Allis-Chalmers Manufacturing Co.	Milwaukee, Wis	[11] 102,575.00	F. o. b. Milwaukee	Do.

[1] Items 1 and 3.
[2] Schedule 1.
[3] Schedule 2.
[4] Items 1, 2, and 3.
[5] Items 1 and 2.
[6] All bids rejected.
[7] Item 1.
[8] Item 2.
[9] Item 3.
[10] Item 4.
[11] Schedule 3.

Shoshone Irrigation District Officers

GEORGE W. ATKINS, Secretary-treasurer of the Shoshone Irrigation District, resigned from the position effective January 15, on account of ill health. Mr. Atkins was one of the first settlers on the Shoshone project, and he has always taken an active part in the water users organizations on the Garland division. He served as a commissioner on the Shoshone Irrigation District Board for a number of years and has been secretary-treasurer of the district from its beginning. He had a good knowledge of project affairs and was a very competent official.

Harry Barrows, of the office of the county treasurer of Park County, has been appointed to succeed Mr. Atkins. Mr. Barrows is a landowner on the Garland division and was cashier of the First National Bank at Powell before becoming county treasurer. He is well qualified for the district position.

• GRAPEFRUIT •

THE grade and quality this season of Yuma Mesa grapefruit are excellent. The average size for the December fruit was 80.

• DAIRY PRODUCE •

THE Yakima Dairy Herd Improvement Association reports that the association members averaged 666 pounds of milk and 26.2 pounds of butterfat per cow for the month of December 1937.

Visitors at Grand Coulee Dam and a Model of the Dam

By S. E. HUTTON, *Assistant Director of Information*

Demonstrator John Holland points out a replica of Seaton's Ferry on the model of the site of Grand Coulee Dam. The model was made accurately, one six-hundredth of the actual size of the things represented.

ON the shortest day in the year, two physicians from Lisbon, Portugal, appeared at the west vista house to see the Grand Coulee Dam. They were just 2 of the 101 visitors on that day, representing 13 States and two foreign countries; two of the 5,288 visitors in December from 35 States and several foreign countries; and two of the 300,000-odd to visit the dam in 1937. More than 12,000 visitors have been handled in a single month, and more than 7,000 in a single day. The average during the summer exceeds 1,000 a day.

During the past year, nearly all the countries of Europe, the principal countries of South America and Asia, and such out-of-the way places as Iceland, Dutch East Indies, Australia, New Zealand, and South Africa were represented by visitors at the dam. In addition to sightseeing tourists, there were among the visitors business men, journalists, public officials, engineers, and technical specialists. One Oriental engineer spent 53 days at the dam studying its design and the details of its construction. A party of officials of Japanese and Manchukuo governments, members of Japanese power companies and contracting firms, and designing engineers spent 8 days studying the project.

Courtesy to Visitors

Most surprising to foreign visitors, particularly the Japanese, are the complete freedom allowed all visitors in using their cameras, and the ease with which they can obtain information from employees of the contractors and of the Bureau of Reclamation.

Most surprising to the Bureau's guides is the universal misconception as to the size of the river, the construction area, and the dam. "Where is the Columbia River?" isn't really a rare question. The great breadth and depth of the river canyon dwarf the river and the project. A foreign visitor who insisted that a much bigger dam had already been built in his own country was astonished to find that in the west end of the base of the Coulee Dam, alone, there was more concrete than in his big dam at home, and that the finished dam would be nearly 10 times as big. Seemingly, most visitors expect to see a deep, narrow canyon of the type shown in pictures of the Boulder and other arch-type dams. Assuming that the mile-wide canyon is "five or six blocks" wide, the visitor naturally underestimates all local dimensions.

To protect themselves from demands on their time which they could not satisfy, and as a matter of safety, local Bureau officials were obliged to devise a scheme and the necessary facilities for handling, on a mass-production basis, the spontaneous crop of visitors that grew as the project developed and became known as a place of extraordinary interest. It was necessary to exclude from construction areas all persons other than workmen on shift, and yet to provide visitors with facilities for seeing things of interest and for getting desired information.

Public-Address Systems

Dignified signs along the highway entering Government property surrounding the dam direct visitors to the parking lots which have been provided for them, one on each side of the river, and to the two vista houses from which active operations are in plain view. Over public-address systems, explanations of features of the project and of the work in progress are given at short intervals between 9 in the morning and 5 in the evening. During the summer months, three men are engaged in this work. Spring and fall, two of these men, who are ordinarily engaged in school work, are on duty Saturdays and Sundays; and in the winter the third man is kept busy handling visitors.

No "canned" speeches are delivered. Starting with descriptions of things within view,

A concealed motor having lifted out of the way a portion of the model, visitors are able to visualize the excavations, totaling more than 20,000,000 yards, which have been made during the years 1933–1937. The demonstrator points out one of the three deep crevices found in the bed rock under the river. At the demonstrator's right may be seen one from which a dam of frozen earth excluded plastic clay which flowed into it from the basin behind it.

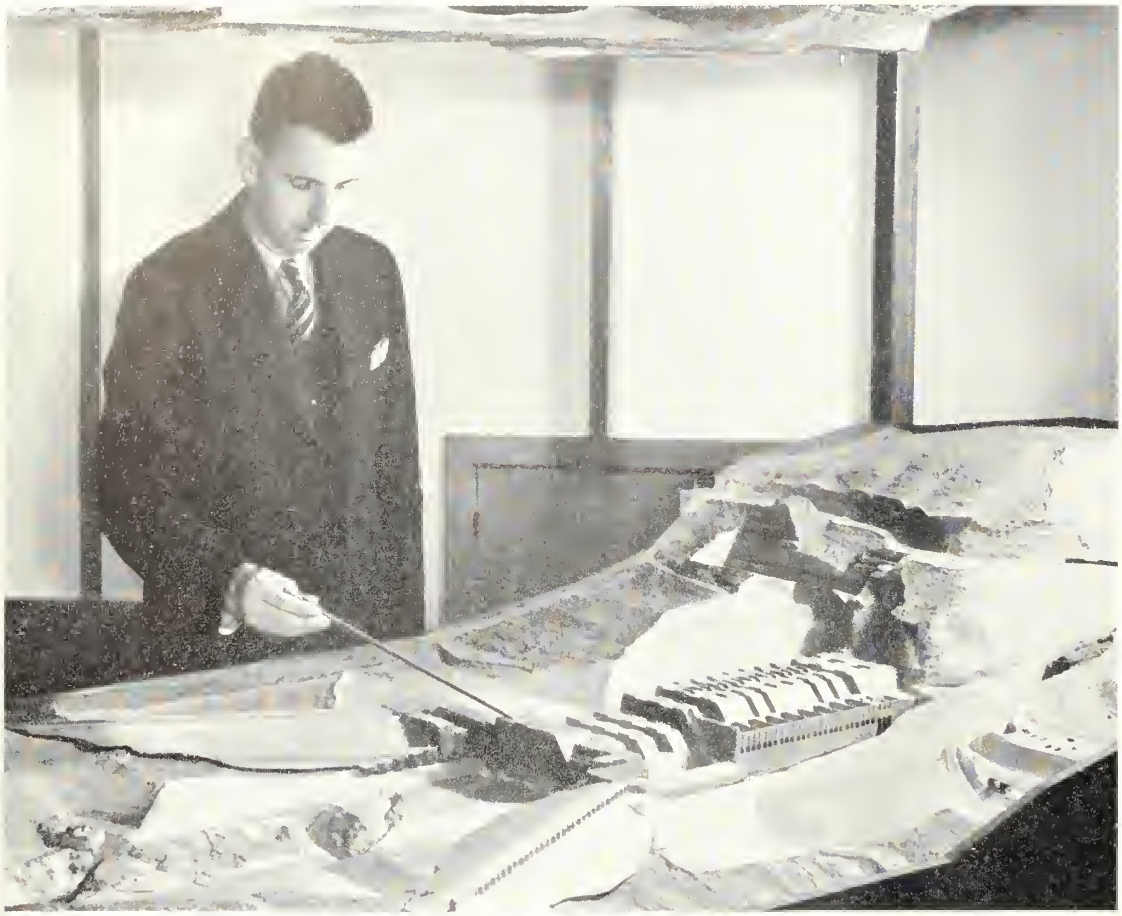
and of immediate interest, the story of the building of the dam is told, and the significance of the Columbia Basin project is explained in such language and at such length as conditions justify. Frequently, the greater part of an audience may be composed of school children, or college students, or delegates to some convention held in the vicinity, or visiting engineers or public officials.

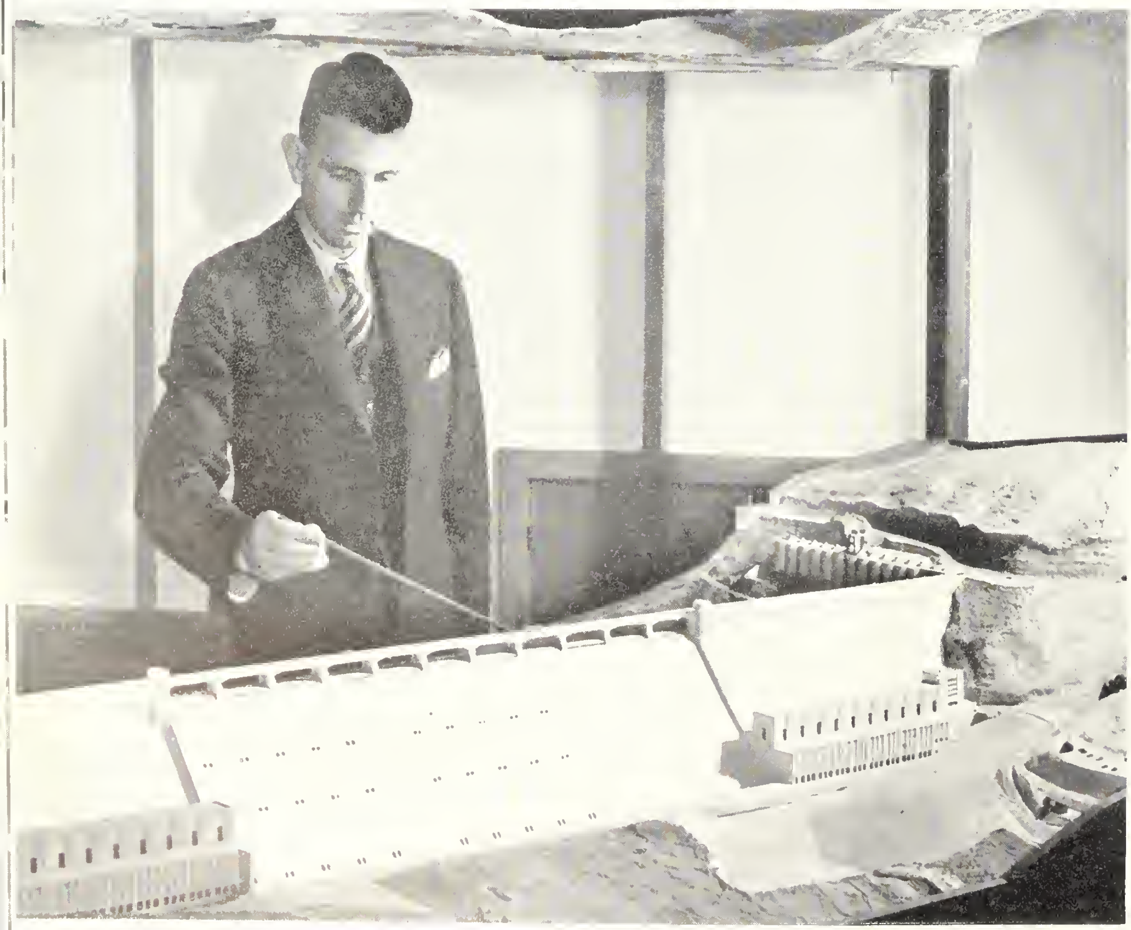
Many questions are asked, usually as to details of the project or construction work, but often with respect to the future development of lands on the project. Sometimes amusing or startling questions appear. Last winter (1936–37) the river was frozen over at the dam, surroundings were snow-covered, and open water was visible only at a distance. A visiting woman inquired, "Why on earth is the dam being built so far from the river?" One visitor wanted to know whether the power to be developed would be of the same quality as that generated at Boulder, and another wondered where the electricity would be stored after it was generated.

Model of Dam

Of great interest not only to nontechnical tourists but to visiting engineers is a model of the dam located on the ground floor of the west vista house. It represents, as first seen by visitors, the vicinity in which the dam is located, one six-hundredth actual size. A concealed motor lifts out of the way, into an overhead position, that part of the model which represents the 20,000,000 yards of sand, clay, boulders, and bedrock moved to make room for the dam, forebays, tailbays, and highways. Surprising to most people are the rugged contours of the bedrock in the excavated area, and the enormity of the job of excavation.

The world's biggest cofferdam, 3,000 feet long and enclosing an area of 60 acres, was built on the west side of the Columbia River at the site of the dam, in the record time of 90 days in the winter of 1934–35. Inside of that cofferdam was built the west end of the base of the dam. The demonstrator points out on a model of the partially completed dam the low gaps left in the base of the dam to serve as diversion channel for the summer flood water of 1937.

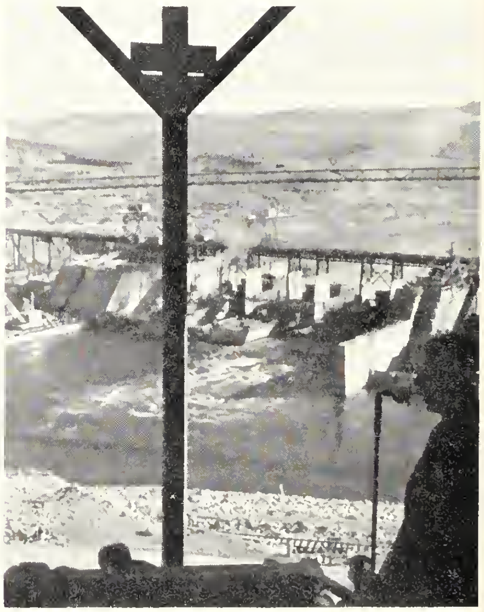




By means of cofferdams built across the river at the site of the dam, the Columbia River was forced out of its natural channel and through low gaps in the west end of the foundation during the high-water season of 1936. During the summer, water ran nearly 20 feet deep over the high blocks in the diversion channel and in the low gaps in the powerhouse section at the end of the dam.

By means of numerous small models, the methods and devices used in diverting the river are demonstrated. Engineers are particularly interested in details of cofferdam design, arrangement, and construction, and the nontechnical are always deeply impressed by the enormous quantities of steel, timber, and labor required to exclude water from the deep excavations and to provide a channel for the river while its old bed of clay and boulders was removed and the base of the dam was built across its channel. An ingenious woman visitor offered the simple solution of damming the river some distance upstream.

A model of the dam and powerhouses fits



Lecturer at the microphone, silhouetted against a portion of the dam.

In an effort to make clear to visitors the magnitude of Grand Coulee Dam, the demonstrator points out a scale model of a highway freight truck and trailer on the 24-foot roadway on the top of the dam. On the opposite sides of the 1,650-foot spillway are the two powerhouses, behind the dam at the right is the pumping plant, and in the spillway section are 60 outlet tunnels and 11 drum gates 28 feet high and 135 feet long.

into the excavated area to show how the whole structure will appear when completed, and the demonstrator explains the purposes of the bucket, 60 outlet tunnels, 11 huge drum-gates, and other features which, in the language of auctioneers, are too numerous to mention.

A besetting difficulty is that of trying to make visitors realize the magnitude of the dam. Models of the vista house and of cars parked near it may help. A model of a freight truck and trailer placed on the highway on the top of the dam is entertaining and may be informative. A never failing item of interest is a minute image of an Indian, represented as returning over the dam to the Nespelem reservation, mounted on a white horse and clad in red pants.

The model was designed and built by a Bureau engineer.

A demonstrator with a model of the cross-section of the dam and powerhouse

Possibilities of Columbia River Development

HON. KNUTE HILL, Representative in Congress from Washington, discussed the "Possibilities of Columbia River Development" over the Columbia Broadcasting System on February 1, in Washington, D. C. Mr. Hill described the three principal results of this development as follows:

"First, cheap electric power for the household and the farm in agricultural sections, and for the homes of laborers, the two groups who most need, and may I say most deserve the necessities and comforts of lift. Secondly, cheap electric power for the development of our untold soil and mineral resources—the surface of which has only been scratched. For example, Idaho has the richest deposit of phosphate rock for fertilizer in the world, estimated at 5,000,000,000 tons; the Cascades have gold, silver, lead, and anthracite—one vein estimated at 50,000,000 tons; 57 different varieties of minerals which will require 3,800,000,000 kilowatts annually for 25 years for processing purposes. Thirdly, attractively reasonable rates for electric power which will be an inducement to capital to construct extensive factories where millions of laborers will find employment. This will relieve the congested sections of many of the large cities of the Midwest and East, and should be welcomed by them. The limitless natural resources of the Pacific Northwest both from the farm and mine will furnish the raw material while the millions of laborers will furnish a market for the products of the farm and factory. The climate is so healthful, the soil so fertile, the scenery so splendid, and the opportunities so great that home life in the Northwest will be real and attractive to all who heed Horace Greeley's advice, 'Go West, young man.'"

In his recapitulation, Mr. Hill emphasizes the possibilities of the development of the Columbia River as follows:

"The bowels of old Mother Earth may, in the not far distant future, cease to yield coal, gas, and oil, but the 'white coal' of the rushing mountain streams is inexhaustible. Electric power will make of the Northwest, a second New England. Erosion and drought may decrease the yield in older sections, and reclamation will make a garden spot of the Northwest for the homeseeker. The now turbulent waters, harnessed and controlled, will become the placid bosom upon which the fruits of the field and the products of the factory will be carried to all parts of the Great Orient.

"It is my firm and sincere conviction that the complete development of the Columbia River system will make of the great Northwest, once declared by the great Webster as the forbidding and inaccessible American desert, a part of the bread basket and also in a large measure, the workshop of the United States. Whirling wheels in factories, bountiful yields from farms, industrious, and lawabiding and prosperous citizens in happy homes must be considered an asset to the whole Nation—a dream worthy of accomplishment by a people who believe in progress, peace, and democracy."

• NEW MUSEUM •

THE Interior Department Museum opened March 8. A full story will appear in the April issue.

National Rivers and Harbors Congress Endorses Reclamation Program [1]

THE Bureau of Reclamation of the Department of the Interior, in carrying out the purposes of the Federal Reclamation Act, undertakes only such irrigation projects as are believed to be self-liquidating, and through the construction of such projects the highest possible use of the lands and water resources of the area are provided, including the conservation of water for domestic and irrigation purposes, flood control, and river regulation, including pollution, abatement, water retardation, increase of low flow for navigation, and such other purposes as may be present.

Because of migration of farm families from the drought areas and from submarginal land, the demand for irrigated land is now far in excess of what the new Federal projects can supply due to inadequate appropriations to carry the work forward as rapidly as could be economically pursued.

The National Rivers and Harbors Congress approves the program of the Bureau of Reclamation, urges that the program be speeded up so that farm families made homeless by drought and erosion be given an opportunity for a new start on land with an assured water supply, and urges Congress to make increased appropriations to accomplish the above purpose.

[1] One of several resolutions adopted at Thirty-third Annual Convention of the National Rivers and Harbors Congress held in Washington, D. C., January 20–21, 1938.

Progress of Investigations of Projects

Kings River-Pine Flat project, California.—Work was continued on the analysis of records of the irrigation districts interested in this project.

Blue River transmountain diversion, Colorado.—Topography was taken at the Parshall dam and reservoir site. Resistance-gradiometer surveys of the Leal dam site and of the tunnel line were completed. Geological examination was made along the Jones Pass tunnel, and a geological report on the Empire tunnel line was completed. A reconnaissance was made for a proposed power plant in Gore Canyon, and a soil survey was in progress. A joint operation study of the proposed Green Mountain and Parshall Reservoirs was completed. Studies were made to determine storage requirements on the South Platte River to regulate the flow of water diverted from the Western Slope.

Colorado-Big Thompson transmountain diversion, Colorado.—Preliminary studies were begun in connection with the use of a power cable through the proposed Continental Divide tunnel.

Eastern Slope surveys, Colorado.—Topographic surveys were completed on several small off-stream reservoir sites of the Smoky Hill River project. On the Cherry Creek project the land classification map was revised and report was ready for review.

Western Slope surveys, Colorado—(a) *Collbran project.*—Surveys were made of two possible alternate creek crossings on the canal line. Computations, estimates and field report were completed. Water supply studies were initiated.

(b) *Florida project.*—Foundation explorations at the lower alternate dam site were completed with test pits and diamond drill holes. Percolation tests were made in the test pits.

(c) *La Plata project.*—Studies of available water at Hesperus and at the State line were made.

(d) *Paonia project.*—A supplemental field report was forwarded to Denver, a feature of which is the inclusion of a pumping plant to supply the Minnesota ditch in lieu of a reservoir on Minnesota Creek.

(e) *Silt project.*—Water supply studies were in progress.

(f) *West Divide project.*—Report was distributed to interested parties for review.

Cabinet Gorge investigations, Idaho.—Diamond drilling is in progress and two holes were completed.

Southwest Idaho investigations (Boise-Weiser-Payette).—A geological examination was made of the tunnel line from Horseshoe Bend in Dry Creek and a report on the geology prepared. A geological report was also prepared for the Garden Valley-Brainard Creek tunnel line. Work was completed on various maps and planetable sheets. Reports were prepared for the Tamarack and Vista reservoir sites. A preliminary water supply study was made to determine the storage requirements on the South Fork of the Boise River.

Buford Trenton investigations, North Dakota.—Economic studies and preliminary designs and estimates were in progress during the month.

Altus project surveys, Oklahoma.—A restudy is being made of the report of the method of setting up the annual costs.

Kenton project, Oklahoma.—Topographic surveys of the dam and spillway sites were completed. A reconnaissance was made of a dam site below the confluence of Cold Springs Arroyo and the Cimarron River. Classification was completed of all the lands which can be served by a gravity diversion from the Cimarron River.

Canby project investigations, Oregon.—Draft of report was completed and reviewed by the State engineer, and under his direction surveys were made for an alternate plan to supply a reduced area by pumping from the Molalla River.

Grande Ronde investigations, Oregon.—A resurvey was begun of the railroad relocation survey around the Lower Grande Ronde reservoir site. Preparation of a general project map was begun. River profiles and alinement have been partially plotted. The profile and cross-sections for the highway relocation around the Catherine Creek reservoir site have been plotted.

Black Hills investigations, South Dakota.—The report on the Rapid Valley project was completed and distributed to interested parties. A small amount of work was done in connection with the water supply studies for the Angostura project.

Utah investigations—(a) *Gooseberry investigations.*—Data are being assembled and checked preparatory to completing and bringing up to date the water supply studies.

(b) *Price River investigations.*—A topographic survey of the Scofield Dam and vicinity was made. Diamond drilling of foundation explorations was begun and one hole completed.

Utah-Idaho-Wyoming investigations—Green River-Bear River surveys.—Work was continued on the traverse and base lines. The area above Cokeville, Wyo., was practically complete. Water supply studies were continued.

Colorado River Basin investigations—(a) *Lower White River project, Colorado.*—Horizontal control was carried on, and classification of the area was continued.

(b) *Little Snake River project, Colorado.*—The establishment of horizontal control and preparation of field sheets was in progress. The mapping of irrigated lands and the classification of undeveloped lands along the Little Snake River near its confluence with the Yampa River was completed.

(c) *Vermillion project, Colorado.*—Horizontal control was begun, field sheets were prepared, and some of the irrigated land was mapped.

(d) *East Fork of Virgin River and Kanab Creek, Utah.*—The mapping of irrigated lands was continued.

(e) *Vernal-Ashley Valley area.*—Horizontal control was started, preparatory to making a land classification to supplement the mapping of irrigated area completed in 1934.

Articles on Irrigation and Related Subjects

ALL-AMERICAN CANAL:

All-American Canal—A summary, illus., Jos. C. Coyle, Excavating Engineer, March 1938, Vol. 32, No. 3, pp. 158–161; 180–183.

CENTRAL VALLEY PROJECT:

Progress on Central Valley project, illus., Eng. News-Record, January 20, 1938, Vol. 120, pp. 109–110.

Central Valley project advances as bid call approaches for Shasta dam, illus., Western Construction News, January 1938, Vol. 13, No. 1, pp. 2–5.

CROZIER, H. W.

Boulder Power reaches pay-dirt, illus., Electrical West, January 1938, Vol. 80, No. 1, pp. 24–26. (Describes Boulder-Pioche line in Nevada.)

GRAND COULEE DAM:

All records for concreting broken in building base for the Grand Coulee Dam, Southwest Builder and Contractor, January 23, 1938, Vol. 91, No. 4, p. 13.

HAYDEN, HON. CARL:

Relation of Western Reclamation to National Progress, Address at Rivers and Harbors Congress, January 21, 1938, Cong. Record, January 25, 1938, Vol. 83, No. 19, pp. 1452–1453.

HENDERSON, RANDALL:

He lost his life's savings, but helped reclaim an empire, portrait of Dr. W. T. Heffernan, who financed Rockwood in development of Imperial Valley, Desert Magazine, February 1938, Vol. 1, No. 4, pp. 14–15 and 31.

Hill, Hon. Knute:
Possibilities of Columbia River development, Cong. Record, February 2, 1938, Vol. 83, No. 25, pp. 1875-1876.

Honeyman, Hon. Nan Wood:
Bonneville (Power) and the Northwest, Cong. Record, January 17, Vol. 83, No. 13, pp. 922-923.

McCrory, S. H.:
S. H. McCrory first John Deere Medalist, portrait, Agricultural Engineering, January 1938, Vol. 19, p. 34.

Murdock, Hon. John R.:
Future developments in the Basin of the Colorado River, Cong. Record, January 21, 1938, Vol. 83, No. 17, pp. 1249-1250.

Noland, T. J., Jr.:
Clearness in engineering writing, Colorado Engineers Bulletin, January 1938, Vol. 22, No. 1, pp. 9-10, 24-25.

Page, John C.:

Labor and reclamation policies of government cited by chief, portrait, The Federal Employee, January 1938, Vol. 23, No. 1, pp. 21-25.

Pierce, Hon. W. M.:
Columbia River Development, Cong. Record, January 19, 1938, Vol. 83, No. 15, pp. 1070-1072.

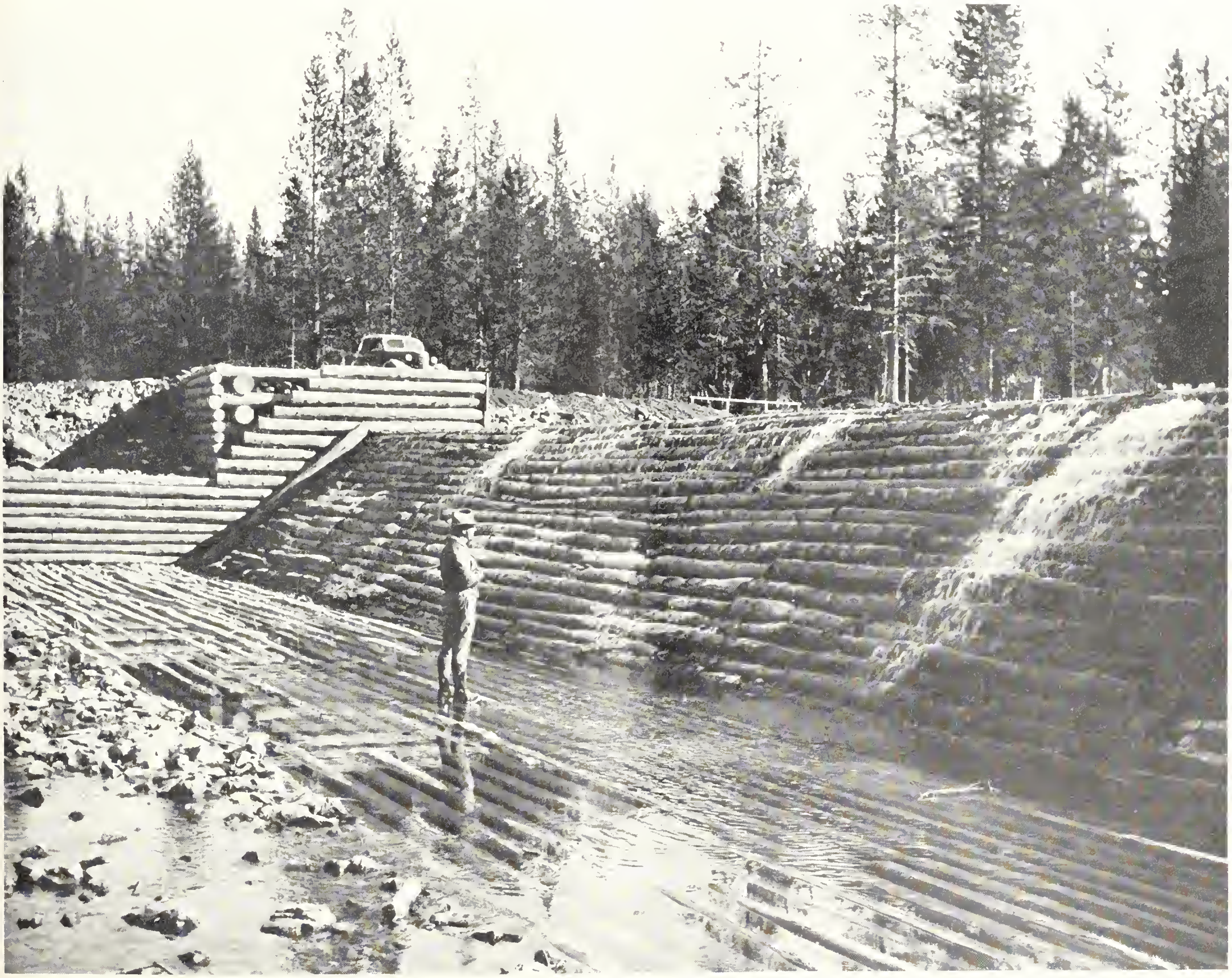
Pine View Dam:
Grouting under an earth dam, illus., Eng. News-Record, January 6, 1938, Vol. 120, No. 1, pp. 15-20.

Reclamation Program:
Bureau of Reclamation program for construction in 1938, illus., Western Construction News, January 1938, Vol. 13, No. 1, pp. 13-16.

Schwellenbach, Hon. L. B.:
Article on Grand Coulee, by Don T. Miller of Okanogan, in the Cong. Record of February 4, 1938, Vol. 83, No. 27, pp. 1966-7, under extension of remarks of Hon. L. B. Schwellenbach.

• LAND SALES •

ANNUAL meetings of 13 national farm loan associations in the Yakima Valley, Wash., were held during January. A very satisfactory volume of land sales was reported for 1937.



The Cascade Creek Diversion Dam, a part of the new Upper Snake River Project, Idaho, designed to serve irrigators of the Snake River Valley with supplemental water. The dam is of rock-filled, log-crib construction.

A Lone Boatman Navigates the Colorado River

By RUPERT P. SPEARMAN, *Assistant Engineer*

ON October 4, 1937, Buzz Holmstrum shoved his small rowboat into the waters of the Green River at Green River, Wyo. and started on a trip full of excitement and thrills down the Colorado River to Boulder Dam. Few, if any, have considered negotiating the treacherous Colorado River alone by boat, and none had tried it until Mr. Holmstrum's trip which was completed on Thanksgiving Day, November 25, 1937.

Shooting rapids of dangerous rivers in this country, is Buzz Holmstrum's idea of a vacation hobby, which started a few years ago on his first trip down the Rogue River in Oregon, from Grant's Pass to Gold Beach on the Pacific. He lost his boat on his first trip and from this experience was born a determination to build another boat that would make this trip. In 1935 he was successful.

In 1936 he completed a trip on the Salmon River from Salmon, Idaho, to Lewiston, Idaho. After this trip, there seemed to be only one river left which might give him greater thrills and more interesting experiences. That river was the Colorado. For nearly a year he spent all of his spare time gathering data on the Colorado River, studying these data, and building his new boat, which would be strong enough to shoot the rapids of the Green and Colorado Rivers.

Navigator Constructs Own Boat

In the construction of his boat, Mr. Holmstrum attempted to secure plans of boats used heretofore on the Colorado River, but since the cost of these plans was prohibitive, he designed his own boat. Infinite care was used in construction. In fact, Mr. Holmstrum stated with pride that he selected the tree, cut and trimmed it personally, and supervised the sawing of it. It is a small rowboat 15 feet long and five feet wide, carrying air compartments at either end to prevent sinking.

"Everybody I talked to and corresponded with advised me against attempting the trip, telling me that it was certain to be fatal, for a lone individual, no matter how well equipped, to battle the rampaging river, as I proposed to do," he explained. "That only made me more determined to try it—also it made me more ready to follow the advice of Maj. J. W. Powell, first human being to traverse the river who declared the secret of his success was in taking infinite care and studying of the rapids in every other little detail with the daily routine."

Mr. Holmstrum further stated that for his trip he secured a plan and provincial map of the Colorado River published by the United States Geological Survey. These maps he studied very carefully, also all other data

Explorer returning from hazardous trip.

he could collect on the Colorado River. On the trip these maps were very valuable to him for nearly every rapid was marked, and he knew where to expect them. To decrease the load in his boat, each map as it served its purpose was thrown away.

Holmstrum carried his own food supplies, stopping at Jensen, and Green River, Utah, and Lee's Ferry and Bright Angel, Ariz., to replenish his stock. For his camping equipment he had a very complete outfit at the start of the voyage, but as the trip progressed, items which he might get along without were discarded and at the end of the trip he was carrying very little.

It is approximately 1,100 miles from Green River, Wyo. to Boulder Dam. Fifty-two days were required to make the trip, of which time, 8 days were spent off the river, securing supplies. While on the river Mr. Holmstrum averaged 25 miles per day, making as a maximum 52 miles one day.

Of the more treacherous rapids the first ones he came upon were in Cataract Canyon where the Green River joins the Colorado. Here he was forced to portage his boat through a severe set of rapids. This, he explained, as his boat was too heavy to carry, means dragging the craft around rocky shoals an inch or two at a time and is "plenty hard work." Here and at other points, rapids were encountered where the canyon walls rise directly from the waters' edge and there was only one way through and that was to "shoot" them. "There was no turning back, after I had once started," he said. "I would have had to leave my boat and climb out of the canyon, which in many places is impossible, and even had I accomplished this, I probably never would have reached civilization through the rough country along the river."

On the day when he was forced to pull and shove the boat most of the time, he made only 4 miles. On two other occasions he had to portage around rapids which he felt were too dangerous to "shoot." Mr. Holmstrum explained that parties that have made the trip previously "lined" many of the dangerous rapids. To "line" a rapid means to maneuver the boat through the rapid by the use of ropes handled from the shore by a number of men. Because it is practically impossible for one man to "line" rapids, he had to "shoot" them. He studied each rapid carefully before starting through it, sometimes spending as long as an hour in mapping a plan of action.

A Close Call

He frankly admitted he was really scared a few times. His closest call came when, as he put it, "I had watched a 'reverse wave' for quite a while, and finally decided it was nothing but water and that I could get through alright. I took one last look before starting, and caught a glimpse of jagged

rock sticking up. If I had headed into the current there, I would have banged into that rock, and wouldn't have been here today to tell the story. And I almost did."

At the Navajo Bridge over the river at Marble Canyon he stopped for supplies. As there was a bridge over the river at this point, he felt he would have no trouble in getting out of the canyon to the store on the north side. But to his dismay he found nearly sheer walls rising a few hundred feet above him. After hours of hard work and at the risk of his life, he managed to make the rim where he obtained his supplies.

At Bright Angel, Ariz., he secured more supplies and while there learned of the geological party from the California Institute of Technology which was somewhere in Grand Canyon farther downstream. A radio message was sent to the Geological party that he was on his way but since no answer was received, he did not know whether they would be expecting him. A few days later he came upon one of their campfires and found a board propped on a pile of rocks. On the board was "Hello Buzz." Those two words meant a lot to him and he is carrying the board home as a souvenir. The following day he caught up to the party and camped with them at Travertine Falls in Travertine Canyon.

The End of the Trail

The last rapids to shoot were Lava Cliff in Spencer Canyon. He then looked forward to Surprise Rapids which were a real surprise to him, for instead of the rapids he found himself on the smooth waters of Lake Mead.

"My first impression when I hit the lake was one of relief," he explained. "I thought 'Hurrah! my troubles are all over now,' but you know something, that sentiment didn't last very long before it was replaced by an empty feeling; it was as though everything I had striven for so long had been accomplished and there was nothing left to do."

Commenting on the trip he said, "It was worth everything it cost me in time, money, and the rest. It seems like I actually lived more in a few hours out there on the river that I have in a year in the city."

During our interview Mr. Holmstrum repeatedly gave all credit for the success of his trip to his boat, and the river. In his own words "I had a sturdy boat and the river was good to me."

Grand Canyon and Lake Mead were the biggest thrills of his voyage; Grand Canyon because of its dangerous rapids and its natural beauty, Lake Mead because of its being man-made.

It required $3\frac{1}{2}$ days to row his boat down Lake Mead to the boat docks. Such was his hurry to complete his trip that he rowed by night, sleeping only a few hours of the last few days.

Explorer in boat on Lake Mead.

Mr. Holmstrum carried with him a camera and took hundreds of photographs of the country through which he traveled. He also kept an intimate diary of his impressions along the way and the events of the trip.

Previous Expeditions

Five expeditions had previously made the trip. First was Maj. J. W. Powell, who with a party of 12 in 4 boats started out from Green River in 1869 and proceeded to Bonnelli's Ferry now submerged in Lake Mead. Three of the men deserted with all notes on the trip, and were massacred by the Indians. Major Powell made another successful trip in 1871. In 1909 Julius Stone and five men in four boats traveled on the river from Green River to Yuma, Ariz. Emergy and Ellsworth Kolb, of Grand Canyon, made the trip in 1911 and Dr. R. G. Frazier, of Salt Lake City, with six in the party made the trip from Green River to Boulder Dam in 1933.

Holmstrum is a service station operator in Coquille, Oreg. He works hard during the year and saves his money for a new vacation experience. At the close of our talk, I asked him what river he would attempt next. His answer was, "I guess I will have to find a new hobby, for there are no more in this country as treacherous as the three down which I have made voyages."

In closing, I wish to express my appreciation to Mr. Holmstrum for kindly granting an interview and to wish him luck with his next hobby, for after his past experiences I am sure he will select one which will be exciting and possibly as dangerous.

Recent Settlement Pamphlets and Circulars

THE following pamphlets and circulars have been issued by the Bureau of Reclamation and are available for free distribution, as long as the supply lasts, at the Bureau's Washington office and also at the project offices indicated:

Printed Pamphlets

Belle Fourche Project, South Dakota, illus., and maps, 28 pages. (Newell, S. Dak.)
Klamath Project, Oregon-California, illus., and maps, 20 pages. (Klamath Falls, Oreg.)
Minidoka Project, Idaho, illus., and maps, 35 pages. (Burley, Idaho.)

Mimeographed Circulars

Belle Fourche Project, South Dakota, Oct. 1, 1937, No. 6145, 4 pages. (Newell, S. Dak.)
Boise Project, Idaho, Oct. 1, 1937, No. 7145, 4 pages. (Boise, Idaho.)
Carlsbad Project, New Mexico, Oct. 1, 1937, No. 8,699, 3 pages. (Carlsbad, N. Mex.)
Grand Valley Project, Colorado, Sept. 15, 1937, No. 5428, 4 pages. (Grand Junction, Colo.)
Klamath Project, Oregon-California, Sept. 1, 1937, No. 4376, 3 pages. (Klamath Falls, Oreg.)
Riverton Project, Wyoming, Oct. 1, 1937, No. 6140, 6 pages. (Riverton, Wyo.)
Shoshone Project, Wyoming, Oct. 1, 1937, No. 6139, 3 pages. (Powell, Wyo.)
Strawberry Valley Project, Oct. 1, 1937, No. 6144, 2 pages. (Strawberry Water Users' Association, Payson, Utah.)
Umatilla Project, Oregon, Oct. 1, 1937, No. 6146, 3 pages. (Pendleton, Oreg.)
Vale Project, Oregon, Oct. 1, 1937, No. 8700, 3 pages. (Vale, Oreg.)
Yakima Project, Washington, Oct. 1, 1937, No. 6142, 3 pages. (Yakima, Wash.)
Yuma Project, Arizona-California, Sept. 15, 1937, No. 5373, 3 pages. (Yuma, Ariz.)

Reclamation Construction Program and Its Problems

By JOHN C. PAGE, *Commissioner of Reclamation*[1]

THE biggest construction program in the history of Federal Reclamation moved forward rapidly during the past year. Sixty-six construction contracts, involving $38,565,000 were completed during the last 12 months and 55 contracts, involving $55,620,000 are in force at this time.

Several major jobs will be put on the market within the next few months, including the Shasta Dam of the Central Valley project in California. This will be one of the outstanding structures in the world.

The relationship between the Bureau of Reclamation and its contractors, most of whom are represented in the heavy construction section of the Associated General Contractors of America, has for the most part been satisfactory. There are a few points I would like to bring out, however, in this regard a little later.

First, I would like to speak briefly and generally about Federal Reclamation. Since 1902 the United States has been engaged in a conservation and improvement program in the semiarid and arid West designed to expand the agricultural basis upon which rests the civilization of one-third of our country. The object of this endeavor is to provide homes and new opportunities for people and to create new wealth for the communities, the States, and the Nation through conserving the meager water resources of the region and applying them beneficially to the unproductive lands.

The worth of the Federal Reclamation program is demonstrated by these facts: About 900,000 persons in 14 of the big Western States have their homes on and are gaining their livelihood from the 3,000,000 acres we have watered. Of approximately $250,000,000 invested by the United States in projects now in operation, nearly $50,000,000 has been repaid to the Federal Treasury by the project water users. All of the funds which go into these Federal Reclamation projects are reimbursable and to the best of our belief virtually all of these expenditures eventually will be recovered.

The construction program now in progress will increase the areas served by Federal projects by about 2,500,000 acres. A generation hence this will mean that perhaps 600,000 or more additional people will be making their homes and their livings, as a result of irrigation, in areas not now populated.

It has long been the practice, though it was not always so, for the Bureau of Reclamation to let its work to contract. This is believed to be good public policy. It makes it possible for the Government to expand or to contract its construction programs without sacrifice of economy through being forced to pull together quickly a great construction machine or quickly to dismantle one.

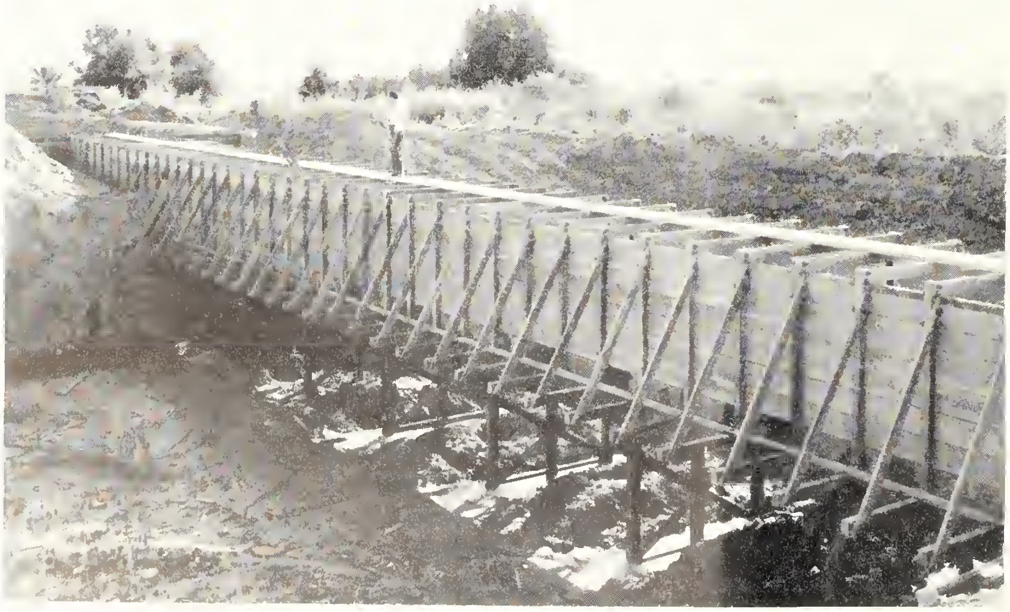
Through long experience the Bureau has familiarized itself with the cost of the work which it undertakes. It can estimate closely what the cost to the Government would be in building a certain structure by force account. It does make these estimates and I need not tell you that when bids are called, the proposals are compared carefully with the estimates made in advance. If the tenders are too high in our estimation, new bids are called. I will say this in behalf of the contractors in America: It is seldom, indeed, that fair bids are not received and it has been a long time since we found it necessary to exercise the right, which we retain, of doing a job ourselves.

There has been a tendency in recent years, when large construction jobs were offered, for a group of contractors to combine themselves into new companies for the purpose of bidding and, if successful, of sharing the responsibility of completing the work. The magnitude of some undertakings, such as Boulder Dam and Grand Coulee Dam, undoubtedly makes it necessary for contractors to pool their interests. However, the practice of forming combinations in these instances might take a form or become so common as to be no longer in the public interest.

Obviously, when 18 contractors submitted individual bids on Boca Dam on the Little Truckee River in California, the competition was keen. If these same contractors had formed three combinations, competition would largely have been stifled. The chances of the Government's receiving the best would have been reduced materially. The contractors do themselves disservice when they combine unnecessarily, or when their combinations are so large as to minimize the chances of receiving truly competitive and representative bids.

During the progress of nearly all large construction, it becomes necessary to make some alteration of the original plans. Per-

Wistaria Canal station, 4 miles west of Calexico, Calif., All-American Canal. Temporary flume canal crossing.



[1] Address delivered February 9 before the Heavy Construction and Railroad Contractors' Division of the Associated General Contractors of America, at its Nineteenth Annual Convention in Washington, D. C.

haps an unexpected weakness is found in the foundation and additional rock excavation is necessary. Perhaps a tunnel must be lined where it was believed the rock would not require support. Perhaps any one of a hundred contingencies makes it necessary to increase or decrease the quantities of excavation or of the materials to be placed in a dam. These contingencies result in change orders modifying the original contract. Some contractors at times have taken advantage of these emergencies and made the change orders the bases of exorbitant claims against the Government. Obviously, it is not the desire of any fair-minded person to place the financial burden of increased costs under these conditions upon the contractor. All will agree that he is entitled to compensation at a fair rate. There have been times, however, when some contractors themselves have taken advantage of these emergencies to present unfair claims against the Government. These instances reflect upon the whole construction industry and they do not further the interests of the contractors in general.

Recently there have been several instances of labor difficulties on our projects. When our contracts are drawn, they include as the minimum rates which the contractor may pay to the men he hires the prevailing rates as determined by the Department of Labor for the various labor classifications in the area of the job. The inclusion of these minimum rates is not a guarantee on the part of the Government to the contractor that he can obtain without difficulty all the labor he may need at the listed prices. The relationships between the contractors and their labor are not the responsibility of the Government, except that the Government must enforce the provisions of its contract, which, on Federal Reclamation projects, include the minimum rates, the 8-hour day and other minor regulations.

Without the aid and cooperation of the contractors of America it would be impossible for the Bureau of Reclamation, or any other agency, to launch in so short a time or to carry forward smoothly a construction program such as that in which we now are engaged. Our program has gone forward without interruption and with a minimum of friction. Our designing staff has been working at top speed, and each job has been offered as soon as the last drawing was completed and the specifications prepared. Each invitation has received the attention of the contractors and generally the invitations have resulted in fair tenders from the construction industry. In addition there has been very little friction between our field offices and the contractors, who together are responsible for getting the work done. In other words, the contract system is working satisfactorily.

Expenditures for Foundation of Grand Coulee Dam in 41 States and District of Columbia

The following table gives data regarding the wide spread of expenditures for the construction of the foundation of the Grand Coulee Dam on the Columbia River in the Northwest, aggregating for the United States Government and the contractor over $32,000,000 to the end of October, 1937.

State	Government	MWAK	Total
Alabama	$209,226.54	$1,000.00	$210,226.51
Arkansas		456.38	456.38
California	148,013.90	2,135,797.35	2,283,811.25
Colorado	108,485.95	48,257.88	156,743.83
Connecticut	4,137.07	62,950.99	67,088.06
Delaware	459.66	193,456.94	193,916.60
Florida		536.23	536.23
Georgia	275.66	2,008.02	2,283.68
Idaho	2,740.81	10,034.62	12,775.43
Illinois	240,904.52	1,810,061.81	2,050,969.33
Indiana	1,099,435.93	5,443.74	1,104,879.67
Iowa	11,393.66	171,891.40	183,285.06
Kansas	7,771.27	10.73	7,782.00
Kentucky		8,109.47	8,109.47
Louisiana		5.40	5.40
Maine		3,166.64	3,166.64
Maryland	27,848.60	43,004.34	70,852.94
Massachusetts	8,017.16	113,711.10	121,728.26
Michigan	30,313.53	211,163.78	241,177.31
Minnesota	116,769.81	725,057.65	841,827.46
Missouri	112,594.37	68,347.07	180,941.44
Montana	286.50	52,394.61	52,681.14
New Jersey	102,347.07	724,033.73	826,380.80
New York	229,601.05	1,190,942.71	1,720,543.76
North Carolina	1,147.77	1,800.00	2,947.77
New Hampshire		170.86	170.86
Nebraska	68.12	179.00	247.42
Nevada	845.85	562.50	1,408.35
Ohio	65,035.31	1,908,795.33	1,973,830.64
Oregon	149,391.30	646,454.12	795,845.42
Pennsylvania	115,822.38	1,544,770.74	1,660,593.12
Rhode Island	2,338.58	3,057.66	5,396.24
South Carolina	204.17	2,000.00	2,204.17
Tennessee	415.51	201.71	617.22
Texas		68.00	68.00
Utah	2,868.30	499.24	3,367.54
Virginia	92.16	792.10	884.26
Washington, D. C	40,659.79	79,218.66	119,878.45
Washington	9,122,841.99	7,709,195.26	16,832,037.25
West Virginia	28,983.74	6,186.91	35,170.65
Wisconsin	83,483.00	207,082.82	290,565.82
Total	12,074,821.33	19,992,880.53	32,067,701.86

The large expenditures in the State of Washington includes cement in excess of 4 million barrels which has kept five cement mills busy night and day for 2 years; some 70,000,000 board feet of lumber; and supplies purchased from local distributions for eastern manufacturers. The total pay roll was nearly $21,000,000.

The following is the data for the seven States in which the expenditures were over $1,000,000 each:

Washington	$16,832,000
California	2,284,000
Illinois	2,051,000
Ohio	1,974,000
New York	1,721,000
Pennsylvania	1,661,000
Indiana	1,104,000

Columbia Basin Area to Have Net of Roads

PRELIMINARY studies have been started by the State highway department looking to the perfection of a model system of highways within the 1,200,000 acres of Columbia Basin lands, according to Lacey V. Murrow, Director of Highways.

"Great savings can be made in the Columbia Basin area highway net by early and proper studies," said Director Murrow. "We are alert to the importance of a road net that will serve the 10,000 families expected eventually to populate the basin area."

Director Murrow said the highway net should be worked out in cooperation with commissioners of counties in the area to be reclaimed, the Bureau of Reclamation and representatives of railroads that will serve the region.

Railways Benefit

"In the last 2 years we have gained a full appreciation of the financial benefits that can result to both highway departments and the railroads in the matter of highway-railway crossings," explained Director Murrow, calling attention to the Federal program of grade separations.

"No doubt we will find much the same situation when we consider highway construction as it crosses the irrigation ditches."

At present the Basin area of 1,200,000 acres of land is crossed by the Sunset Highway, Columbia Basin Highway, North Central Highway, and the recently constructed connection from Ritzville to the North Central above Vantage Ferry.—*Spokane Chronicle, September 6, 1937.*

• ORLAND •

WITH the aid of a grant of W. P. A. funds the town of Orland, Calif., has launched an ambitious program providing much needed recreational facilities. An 18-acre tract of land adjoining the high-school grounds has been acquired and is being graded for a soft-ball field and children's playground. A concrete swimming pool 50 by 125 feet is being built and the water supply for this will be pumped from wells. It is planned to make the tract into an attractive park and thus fill a long-felt need.

Appointment

Boulder Canyon:

Oskar J. W. Hansen, of Virginia, was recently appointed by the Secretary of the Interior to the position of consulting sculptural engineer for decoration of the Boulder Dam.

• LIVESTOCK •

LIVESTOCK growers on the Sanpete project, Utah, have been saved thousands of dollars in feed bills as a result of the mild winter weather, and although practically no extra feeding has been done, both cattle and sheep are in good condition.

Weed Control on Irrigation Projects

By B. E. HAYDEN, *Superintendent, Klamath Project*

THE problem of weed control on irrigation projects is one that cannot longer be sidestepped by farmers and responsible officials if irrigated areas are to hold their favored position in progressive agriculture. While farmers and operation and maintenance employees have been busy producing high-value crops and keeping canals and structures in order, many varieties of perennial and some annual varieties of weeds, which unless controlled will eventually possess the land, have established themselves so extensively that their control will be both laborious and expensive.

Some of the more persistent varieties that have become established on the Klamath project are: White top, Russian knapweed, morning glory, leafy spurge, Canada thistle, puncture vine, and water hemlock. This is by no means the full list of weeds that should be watched but comprehends enough work to keep every farmer on his toes for many, many moons.

The County Agricultural Agent, C. A. Henderson, and his staff, with the substantial backing by the county court, have been carrying on a constant warfare with all destructive noxious weeds prevalent in the Klamath Basin for a number of years, but more recently have expanded the work in a very comprehensive way and to the full extent of available funds.

Early in the spring of 1937 an active weed control program, under Mr. Henderson's direct supervision, was initiated. A county weed inspector was maintained on a yearly basis and additional inspectors appointed as needed under his supervision during the heavy growing season. With this force of trained men, work was carried on by county crews, C. C. C. crews, and Reclamation operation and maintenance crews employed in cutting noxious weeds on ditch banks, drains and highways throughout the project. A total of approximately 3,000 acres of weeds were cut.

Another phase of the work was the giving of instructions and assistance to farmers who were alive to the danger and willing to cooperate. Summer fallowing and clean cultivation were stressed, with the result that clean cultivation was practised on 61 acres of white top, 15 acres of Canada thistle, 12 acres of leafy spurge, 10 acres of morning glory, and 1 acre of knapweed.

This method of control, no doubt, offers the best opportunity for practical work and considerable progress is being made. In addition to the above, a total of 72.7 acres were treated with oil, 25.77 acres on Reclamation property, 13.4 acres on county property, and 33.51 acres on privately owned land. This was applied at a pressure of approximately 200 pounds with a Hardie sprayer. Apparently, oil applied under pressure has more killing power than applied by other means. Plots sprayed a year ago showed the roots of white top and other noxious weeds to be killed to a depth of 10 to 20 inches, with a total kill of 60 to 95 percent. Further spraying this year increased the kill.

A total of 16,500 gallons of diesel oil was applied on Reclamation property, 8,580 gallons on county roadsides, 21,470 gallons on private property at the owners' cost—total of 46,550 gallons of oil used at a cost of $6.25 per 100 gallons.

Sodium chlorate, amounting to 6,500 pounds, was used in powder form for fall treatment, at an acre cost of $129.68. A total of 6.12 acres of public land was treated and 1.46 acres of privately owned land at the owner's cost.

Assistance was rendered the Bureau of Reclamation by the county agent's force in the planting of a considerable area of ditch banks with aggressive grasses to prevent further weed infestation.

Total county appropriation for 1937 weed control operations was $7,500. Diesel oil, in the amount of 11,000 gallons, was furnished by the Bureau of Reclamation. The county money was used mainly in supervision, experimental work, hiring of inspectors, control of noxious weeds on publicly owned lands, and in cooperation with other State, Federal, and private agencies. Cooperation has been maintained between the Bureau of Reclamation, various irrigation districts and all other agencies in the county. An active educational program was carried on with the Grange and other farm organizations. A set of 10 weed mounts was prepared and distributed to granges and other organizations of the county and exhibited for the information of farmers and their sons. It is felt that education still is an important part of weed control and that considerable progress has been made this year. (See opposite page.)

The encouraging feature of this year's work is the interest shown by many land owners who have taken active steps for the first time in controlling noxious and perennial weeds on their property. Also, the controlling of annual and biennial weeds by cultivation has made considerable progress this season.

A junior weed project, with 4-H and F. F. A. boys and girls, was worked out and put in effect, with good success. This project created considerable interest on the part of adults as well, and it is hoped that interest will be even greater next year.

Contract Awarded for Construction of Vallecito Dam

APPROVAL of the award of the contract, for construction of Vallecito Dam, the major engineering feature of the new Pine River Federal Reclamation project, was announced on February 17 by the Secretary of the Interior, Harold L. Ickes. The contract will go to the Martin Wunderlich Co. of Jefferson City, Mo., on its bid of $2,115,870.

Vallecito Dam will be an earth structure, rising about 125 feet, which will stretch approximately 1,000 feet across the Pine River above Bayfield, Colo.

The dam will create a reservoir of 125,000 acre-feet capacity for the irrigation of 69,000 acres. Of the total acreage to be served, approximately 35,000 are now receiving water through canals already constructed. The supply of this area will be supplemented. About 19,000 acres of the land involved belong to Indians.

The successful bid was the lowest of nine proposals received and opened by the Bureau of Reclamation at its Durango, Colo., office on November 16 last. While the contract will be awarded, notice to the contractor to proceed with the work will be withheld temporarily, pending approval as to form of the repayment contract with the Pine River Irrigation District and a memorandum of understanding between the Bureau of Indian Affairs and the Bureau of Reclamation. The contractor will be expected to begin work within 30 days after receipt of notice to proceed and must complete construction of the dam in 1,350 calendar days.

Vallecito Dam will have a reinforced concrete outlet conduit constructed in an open cut at the right abutment and a concrete-lined open channel spillway at the same abutment. The outlet conduit will be 610 feet long and will open into the spillway channel, which will be approximately 2,330 feet long. The discharge over the spillway will be controlled by three radial gates, each 37 feet long and 19 feet high.

Weed mounts exhibited at Klamath granges and county organizations.

Reclamation Organization Activities

Commissioner Page Addresses Wild Life Conference

JOHN C. PAGE, Commissioner of Reclamation, delivered an address on February 15, at the Third North American Wild Life Conference in Baltimore in connection with a discussion of the question: What is or should be the status of wild life in drainage and reclamation planning? Mr. Page's subject was "Reclamation Aids Wild Life."

W. R. Nelson Addresses Rotary Club

ON March 3 at Ellicott City, Maryland, W. R. Nelson, Chief of the Engineering Division, addressed the Rotary Club of that City. His subject "The Reclamation Program" was illustrated with lantern slides. The Boulder Dam sound film was shown following the lecture.

Ray B. Dame, Associate Director of the Division of Motion Picture, accompanied Mr. Nelson and took charge of the projection of the lantern slides and motion pictures. Preceding the lecture Mr. Nelson and Mr. Dame were guests of the Chairman of the Program Committee at dinner.

E. B. Debler in Washington

E. B. DEBLER, hydraulic engineer in the Denver office, was called to Washington on February 14 to spend a short time in consideration of Central Valley project matters.

H. D. Comstock

H. D. COMSTOCK, Superintendent of the Riverton project, Wyoming, was elected a director of the Wyoming section of the American Society of Civil Engineers at a meeting held in February in Casper, at which time the state group was organized.

C. M. White and T. D. Eberhart, Retired

ON January 31, C. M. White, storekeeper on the Yuma project was retired from active service in the Bureau of Reclamation, having reached the retirement age.

Mr. White entered the employ of the Bureau on March 1, 1904, as storekeeper at Yuma, resigned in 1909, and was reinstated in his former position in August 1922, since which time he has been continuously employed on the Yuma project. Mr. White intends to spend his retirement among members of his family in Yuma and Tuscon.

T. D. Eberhart, whose retirement was effective also on January 31, has had a varied experience on the Yuma project which began in August 1907. He has served in the positions of pump operator, caterpillar driver, dredge engineer, dragline operator, and operator of the pumping station. Many of the drainage canals in the valley division of the Yuma project were excavated by draglines operated by Mr. Eberhart. He has served as operator at the boundary pumping station since 1931. Mr. Eberhart and his wife will reside in Los Angeles where they have property interests.

On leaving the Government service, fellow employees on the Yuma project presented Mr. White with a modern edition of the Holy Bible, and Mr. Eberhart with a billfold and key case.

Appointments

THE following appointments were recently authorized by the Secretary of the Interior:

Denver Office:

Thomas H. Peterson, junior engineer, by transfer from same position U. S. Engineer Office, War Department, Bonneville, Oreg. (vice Arthur P. Gardiner, resigned).

Walter E. Sims, probationally appointed junior engineer, Colorado-Big Thompson project, Littleton, Colo., by change in designation from planetableman.

Transfers

THE following transfers were recently authorized by the Secretary of the Interior:

To Denver Office:

Vand E. Larson, associate engineer, from Burnt River project, Unity, Oreg.

Wilfred L. Karrer, associate engineer, from Owyhee project, Boise, Idaho.

I. Donald Jerman, engineer, from Upper Snake River project, Ashton, Idaho.

To Central Valley project:

Irvin D. Wolfe, from electrician, Boulder Canyon project to camp superintendent, Friant division, Friant, Calif.

Max R. Johnson, assistant Engineer, from Ontario, Oreg. (Owyhee project) to the Delta division, Antioch, Calif.

To Columbia Basin project:

David E. Bunger, assistant reclamation economist, from the Colorado River Basin Investigations, Vernal, Utah.

Herman F. Bahmeier, engineer, from Upper Snake River project, Ashton, Idaho.

To Buffalo Rapids project:

Donald R. Burnett, assistant engineer, from Burnt River project, Unity, Oregon.

Retirement

EDWARD A. DACEY, Chief Draftsman, Washington Office, on account of disability which became effective retroactively May 1937.

Separations

The following separations have been effected:

Denver Office:

Harry L. Wingfield, Jr., junior engineer, to accept offer of employment with the Washington State Highway Department, Olympia, Wash.

Harry Smith, junior engineer, Kendrick project, to care for personal matters.

Wedding

MISS AGNES W. AUTH in the Accounting division, and Charles H. Peckham, in the Chief Clerk's division, both clerks in the Washington Office, were married on January 20, 1938. Congratulations Mr. and Mrs. Peckham.

ADDRESS on Grand Coulee Dam

GUY ATKINSON, member of the firm of the Mason-Walsh-Atkinson-Kier Co., gave an interesting illustrated address on the construction of the foundation of the Grand Coulee Dam on February 9, before a joint meeting of four of the large engineering organizations in Washington. He described the methods for diverting the river: how six men by electric buttons control the production of 15,000 cubic yards of concrete per day; and how the leak in the cofferdam was stopped by the use of sawdust, cement, and bentonite.

Mr. Atkinson described the town of Mason City, where the men lived, its dormitories, mess houses, hospital, and buildings without chimneys, and how, owing to the use of electric current at a very cheap rate for heating and all household purposes, the monthly bills ranged from $6 to $8. He ended with a tribute to the far-seeing policy of President Roosevelt in planning for the development of 1,200,000 acres of land for the farm homes on the Columbia Basin project.

U. S. GOVERNMENT PRINTING OFFICE: 1938

ADMINISTRATIVE ORGANIZATION OF THE BUREAU OF RECLAMATION

HAROLD L. ICKES, SECRETARY OF THE INTERIOR

——— ———, FIRST ASSISTANT SECRETARY, in charge of reclamation

John C. Page, Commissioner — **Roy B. Williams,** Assistant Commissioner

J. Kennard Cheadle, Chief Counsel and Assistant to Commissioner; Miss Mae A. Schnurr, Chief, Division of Public Relations; George O. Sanford, General Supervisor of Operation and Maintenance; D. S. Stuver, Asst. Gen. Supr.; Wesley R. Nelson, Chief, Engineering Division; P. I. Taylor, Assistant Chief; A. R. Golzé, Supervising Engineer, C. C. C. Division; William F. Kubach, Chief Accountant; Charles N. McCulloch, Chief Clerk; Jesse W. Myer, Chief, Mails and Files Division; Miss Mary E. Gallagher, Secretary to the Commissioner

Denver, Colo., United States Customhouse

R. F. Walter, Chief Eng.; S. O. Harper, Asst. Chief Eng.; J. L. Savage, Chief Designing Eng.; W. H. Nalder, Asst. Chief Designing Eng.; L. N. McClellan, Chief Electrical Eng.; Kenneth B. Keener, Senior Engineer, Dams; H. R. McBirney, Senior Engineer, Canals; E. B. Debler, Hydraulic Eng.; I. E. Houk, Senior Engineer, Technical Studies; Spencer L. Baird, District Counsel; L. R. Smith, Chief Clerk; Harry Caden, Fiscal Agent; A. McD. Brooks, Purchasing Agent; C. A. Lyman and Henry W. Johnson, Field Representatives; L. S. Davis, Engineer, C. C. C. Division

Projects under construction or operated in whole or in part by the Bureau of Reclamation

Project	Office	Official in charge		Chief clerk	District counsel	
		Name	Title		Name	Address
All-American Canal [1]	Yuma, Ariz.	Leo J. Foster	Constr. engr.	J. C. Thrailkill	R. J. Coffey	Los Angeles, Calif.
Belle Fourche	Newell, S. Dak.	F. C. Youngblutt	Superintendent	J. P. Siebeneicher	W. J. Burke	Billings, Mont.
Boise	Boise, Idaho	R. J. Newell	Constr. engr.	Robert B. Smith	B. E. Stoutemyer	Portland, Oreg.
Boulder Dam and power plant [1]	Boulder City, Nev.	Ralph Lowry	Constr. engr.	Gail H. Baird	R. J. Coffey	Los Angeles, Calif.
Buffalo Rapids	Glendive, Mont.	Paul A. Jones	Constr. engr.	Edwin M. Bean	W. J. Burke	Billings, Mont.
Burnt River	Unity, Oreg.	Clyde H. Spencer	Constr. engr.		B. E. Stoutemyer	Portland, Oreg.
Carlsbad	Carlsbad, N. Mex.	L. E. Foster	Superintendent	E. W. Shepard	H. J. S. Devries	El Paso, Tex.
Central Valley	Sacramento, Calif.	W. R. Young	Constr. engr.	E. R. Mills	R. J. Coffey	Los Angeles, Calif.
Colorado-Big Thompson	Denver, Colo.				J. R. Alexander	Salt Lake City, Utah.
Colorado River	Austin, Tex.	Ernest A. Moritz	Constr. Engr.	William F. Sha	H. J. S. Devries	El Paso, Tex.
Columbia Basin	Coulee Dam, Wash.	F. A. Banks	Constr. engr.	C. B. Funk	B. E. Stoutemyer	Portland, Oreg.
Gila	Yuma, Ariz.	Leo J. Foster	Constr. engr.		R. J. Coffey	Los Angeles, Calif.
Grand Valley	Grand Junction, Colo.	W. J. Chiesman	Superintendent	Emil T. Ficenec	J. R. Alexander	Salt Lake City, Utah.
Humboldt	Lovelock, Nev.	Stanley R. Marean	Resident engr.[2]	George B. Snow	J. R. Alexander	Salt Lake City, Utah.
Kendrick	Casper, Wyo.	H. W. Bashore	Constr. engr.	C. M. Voyen	W. J. Burke	Billings, Mont.
Klamath	Klamath Falls, Oreg.	B. E. Hayden	Superintendent	W. I. Tingley	B. E. Stoutemyer	Portland, Oreg.
Milk River	Malta, Mont.	H. H. Johnson	Superintendent	E. E. Chabot	W. J. Burke	Billings, Mont.
Fresno Dam	Havre, Mont.	H. V. Hubbell	Constr. engr.	E. E. Chabot	W. J. Burke	Billings, Mont.
Minidoka	Burley, Idaho	Dana Templin	Superintendent	G. C. Patterson	B. E. Stoutemyer	Portland, Oreg.
Moon Lake	Duchesne, Utah	E. J. Westerhouse	Constr. engr.	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
North Platte	Guernsey, Wyo.	C. F. Gleason	Supt. of power	A. T. Stimpfig	W. J. Burke	Billings, Mont.
Orland	Orland, Calif.	D. L. Carmody	Superintendent	W. D. Funk	R. J. Coffey	Los Angeles, Calif.
Owyhee	Boise, Idaho	R. J. Newell	Constr. engr.	Robert B. Smith	B. E. Stoutemyer	Portland, Oreg.
Parker Dam	Parker Dam, Calif.	Howard P. Bunger	Constr. engr.	George W. Lyle	R. J. Coffey	Los Angeles, Calif.
Pine River	Durango, Colo.	Charles A. Burns	Constr. engr.	John S. Martin	J. R. Alexander	Salt Lake City, Utah.
Provo River	Salt Lake City, Utah	E. O. Larson	Engineer	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
Rio Grande	El Paso, Tex.	L. R. Fiock	Superintendent	H. H. Berryhill	H. J. S. Devries	El Paso, Tex.
Caballo Dam	Caballo, N. Mex.	S. F. Crecelius	Constr. engr.	H. H. Berryhill	H. J. S. Devries	El Paso, Tex.
Riverton	Riverton, Wyo.	H. D. Comstock	Superintendent	C. B. Wentzel	W. J. Burke	Billings, Mont.
Bull Lake Dam	Riverton, Wyo.	Arthur P. Smyth	Resident engr.		W. J. Burke	Billings, Mont.
Salt River	Phoenix, Ariz.	E. C. Koppen	Constr. engr.	Edgar A. Peek	R. J. Coffey	Los Angeles, Calif.
Sanpete	Salt Lake City, Utah	E. O. Larson	Engineer	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
Shoshone	Powell, Wyo.	L. J. Windle	Superintendent [2]	L. J. Windle[2]	W. J. Burke	Billings, Mont.
Heart Mountain division	Cody, Wyo.	Walter F. Kemp	Constr. engr.	L. J. Windle	W. J. Burke	Billings, Mont.
Sun River, Greenfields division	Fairfield, Mont.	A. W. Walker	Superintendent		W. J. Burke	Billings, Mont.
Truckee River Storage	Reno, Nev.	Charles S. Hale	Constr. engr.	George B. Snow	J. R. Alexander	Salt Lake City, Utah.
Umatilla (McKay Dam)	Pendleton, Oreg.	C. L. Tice	Reservoir supt.		B. E. Stoutemyer	Portland, Oreg.
Uncompahgre: Repairs to canals	Montrose, Colo.	C. B. Elliott	Constr. engr.	Ewalt P. Anderson	J. R. Alexander	Salt Lake City, Utah.
Upper Snake River Storage [3]	Ashton, Idaho	H. A. Parker	Constr. engr.	Emmanuel V. Hillius	B. E. Stoutemyer	Portland, Oreg.
Vale	Vale, Oreg.	C. C. Ketchum	Superintendent		B. E. Stoutemyer	Portland, Oreg.
Yakima	Yakima, Wash.	J. S. Moore	Superintendent	Philo M. Wheeler	B. E. Stoutemyer	Portland, Oreg.
Roza division	Yakima, Wash.	Charles E. Crownover	Constr. engr.	Alex S. Harker	B. E. Stoutemyer	Portland, Oreg.
Yuma	Yuma, Ariz.	R. C. E. Weber	Superintendent	Noble O. Anderson	R. J. Coffey	Los Angeles, Calif.

[1] Boulder Canyon. [2] Acting. [3] Island Park and Grassy Lake Dams.

Projects or divisions of projects of Bureau of Reclamation operated by water users

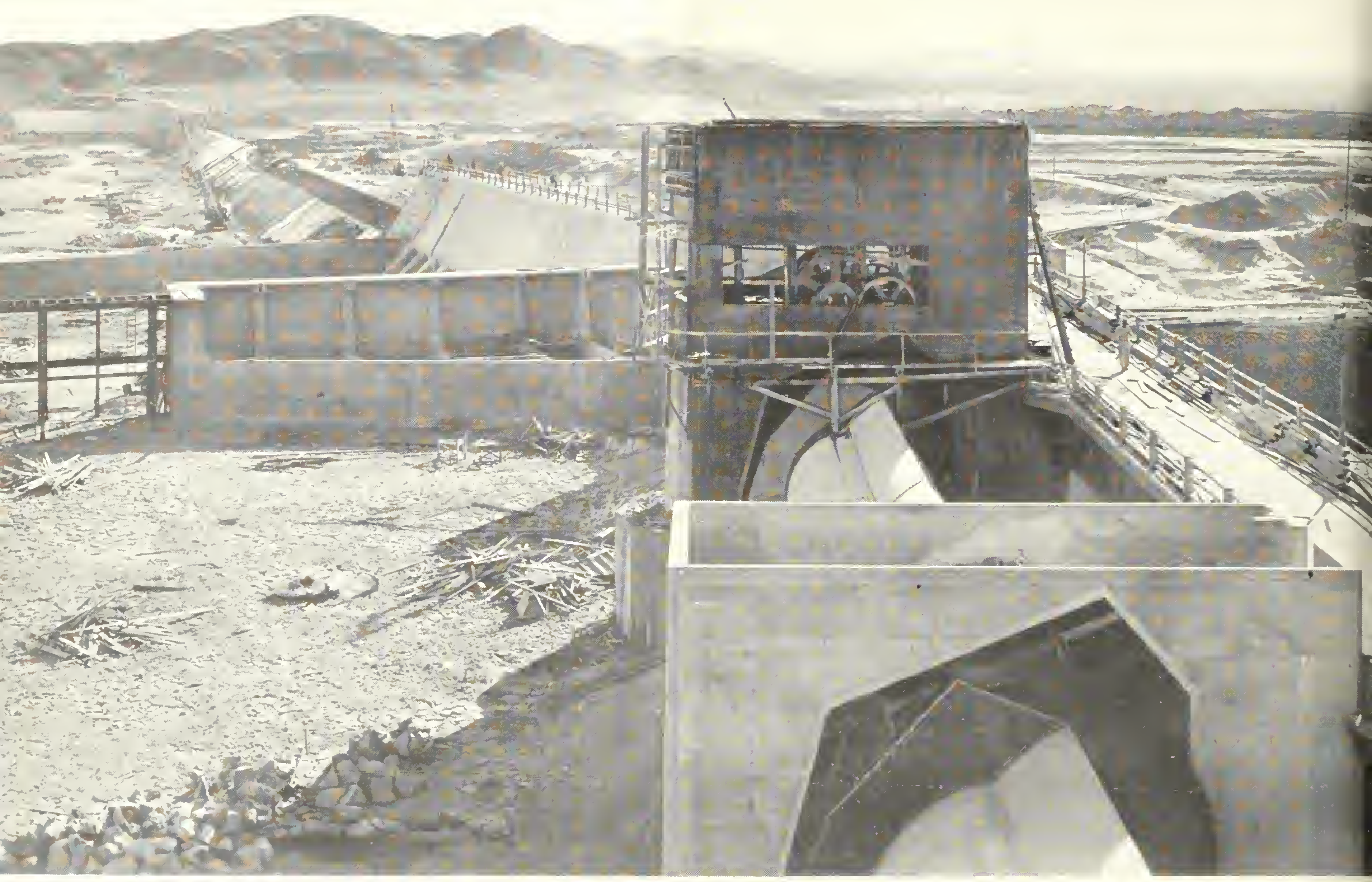
Project	Organization	Office	Operating official		Secretary	
			Name	Title	Name	Address
Baker (Thief Valley division) [1]	Lower Powder River irrigation district	Baker, Oreg.	A. J. Ritter	President	F. A. Phillips	Keating.
Bitter Root [4]	Bitter Root irrigation district	Hamilton, Mont.	N. W. Blindauer	Manager	Elsie H. Wagner	Hamilton.
Boise [1]	Board of Control	Boise, Idaho	Wm. H. Tuller	Project manager	F. J. Hanagan	Boise.
Boise [1]	Black Canyon irrigation district	Notus, Idaho	W. H. Jordan	Superintendent	L. M. Watson	Caldwell.
Frenchtown	Frenchtown irrigation district	Frenchtown, Mont.			Ralph P. Scheffer	Huson.
Grand Valley, Orchard Mesa [3]	Orchard Mesa irrigation district	Grand Jctn., Colo.	C. W. Tharp	Superintendent	C. J. McCormich	Grand Jctn.
Huntley [4]	Huntley irrigation district	Ballantine, Mont.	E. E. Lewis	Manager	H. S. Elliott	Ballantine.
Hyrum [3]	South Cache W. U. A.	Hyrum, Utah	B. L. Mendenhall	Superintendent	Harry C. Parker	Logan.
Klamath, Langell Valley [1]	Langell Valley irrigation district	Bonanza, Oreg.	Chas. A. Revell	Manager	Chas. A. Revell	Bonanza.
Klamath, Horsefly [1]	Horsefly irrigation district	Bonanza, Oreg.	Henry Schmor, Jr.	President	Dorothy Eyers	Bonanza.
Lower Yellowstone [4]	Board of Control	Sidney, Mont.	Axel Persson	Manager	Axel Persson	Sidney.
Milk River: Chinook division [4]	Alfalfa Valley irrigation district	Chinook, Mont.	A. L. Benton	President	R. H. Clarkson	Chinook.
Minidoka: Gravity [1]	Minidoka irrigation district	Rupert, Idaho	Frank A. Ballard	Manager	O. W. Paul	Rupert.
Pumping [1]	Burley irrigation district	Burley, Idaho	Hugh L. Crawford	Manager	Frank O. Redfield	Burley.
Gooding [1]	Amer. Falls Reserv. Dist. No. 2	Gooding, Idaho	S. T. Baer	Manager	P. T. Sutphen	Gooding.
Newlands [3]	Truckee-Carson irrigation district	Fallon, Nev.	W. H. Wallace	Manager	H. W. Emery	Fallon.
North Platte: Interstate division [4]	Pathfinder irrigation district	Mitchell, Nebr.	T. W. Parry	Manager	Flora K. Schroeder	Mitchell
Fort Laramie division [4]	Gering-Fort Laramie irrigation district	Gering, Nebr.	W. O. Fleenor	Superintendent	C. G. Klingman	Gering.
Fort Laramie division [4]	Goshen irrigation district	Torrington, Wyo.	Bert L. Adams	Superintendent	Mary E. Harrach	Torrington.
Northport division [4]	Northport irrigation district	Northport, Nebr.	Mark Iddings	Superintendent	Mabel J. Thompson	Bridgeport.
Ogden River	Ogden River W. U. A.	Ogden, Utah	Ora Bundy	President		Ogden.
Okanogan [1]	Okanogan irrigation district	Okanogan, Wash.	Nelson D. Thorp	Manager	Nelson D. Thorp	Okanogan.
Salt Lake Basin (Echo Res.) [3]	Weber River Water Users' Assn.	Ogden, Utah	D. D. Harris	Manager	D. D. Harris	Layton.
Salt River [2]	Salt River Valley W. U. A.	Phoenix, Ariz.	H. J. Lawson	Superintendent	F. C. Henshaw	Phoenix.
Shoshone: Garland division [4]	Shoshone irrigation district	Powell, Wyo.	M. P. McLaughlin	Irri. superintendent	Harry Barrows	Powell.
Frannie division [4]	Deaver irrigation district	Deaver, Wyo.	Floyd Lucas	Superintendent	Lee N. Richards	Deaver.
Strawberry Valley [3]	Strawberry Water Users' Assn.	Payson, Utah	S. W. Grotegut	Manager	E. G. Breeze	Payson.
Sun River: Fort Shaw division [4]	Fort Shaw irrigation district	Fort Shaw, Mont.	E. J. Gregory	Manager	E. J. Gregory	Fort Shaw.
Greenfields division [4]	Greenfields irrigation district	Fairfield, Mont.	A. W. Walker	Manager	H. P. Wangen	Fairfield.
Umatilla: East division [1]	Hermiston irrigation district	Hermiston, Oreg.	E. D. Martin	Manager	Enos D. Martin	Hermiston.
West division [1]	West Extension irrigation district	Irrigon, Oreg.	A. C. Houghton	Manager	A. C. Houghton	Irrigon.
Uncompahgre [3]	Uncompahgre Valley W. U. A.	Montrose, Colo.	Jesse R. Tompson	Acting superintendent	J. Frank Anderson	Montrose.
Yakima, Kittitas division [1]	Kittitas reclamation district	Ellensburg, Wash.	V. W. Russell	Manager	G. L. Sterling	Ellensburg.

[1] B. E. Stoutemyer, district counsel, Portland, Oreg.
[2] R. J. Coffey, district counsel, Los Angeles, Calif.
[3] J. R. Alexander, district counsel, Salt Lake City, Utah.
[4] W. J. Burke, district counsel, Billings, Mont.

Important investigations in progress

Project	Office	In charge of—	Title
Colorado River Basin, sec. 15	Denver, Colo.	P. J. Preston	Senior engineer.
Boise-Weiser-Payette	Boise, Idaho	Lester C. Walker	Engineer.
Kings River-Pine Flat	Fresno, Calif.	John R. Iakisch	Constr. engineer.
Western Slope (Colo.)	Denver, Colo.	Frank C. Merriell	Engineer.
Black Hills	Denver, Colo.	R. E. Kennedy	Assistant engineer.
Eastern Slope (Colo.)	Denver, Colo.	A. N. Thompson	Engineer.
Salt Lake Basin	Salt Lake City, Utah	E. O. Larson	Engineer.
Grande Ronde	La Grande, Oreg.	C. C. Fisher	Engineer.

Issued monthly by the Bureau of Reclamation, Department of the Interior, as approved by the Director of the Budget. SALLIE A. B. COE, *Editor*.



Top: Looking across dam toward Arizona abutment from top of roller gate control house.

Bottom: Looking along center line of overflow weir from Gila Headworks. California abutment in background.

THE RECLAMATION ERA

APRIL 1938

BELLFLOWER APPLE ORCHARD IN BLOSSOMTIME ON THE UNCOMPAHGRE PROJECT, COLORADO

EBERT K. BURLEW

FIRST ASSISTANT SECRETARY OF THE INTERIOR

EBERT K. BURLEW, nominated by President Roosevelt as First Assistant Secretary of the Department of the Interior, and confirmed by the Senate on April 5, 1938, is a career man in Government with 27 years' civil-service standing.

By virtue of extensive travel and 14 years' intimate knowledge of the work of the Bureau of Reclamation, National Park Service, Geological Survey, General Land Office, Office of Indian Affairs, and other bureaus of the Department, he brings to the Office of First Assistant Secretary a personal knowledge of the needs and desires of the West.

Commenting on Mr. Burlew's nomination, Secretary of the Interior Ickes said:

"I have found Mr. Burlew's knowledge of Government procedure, his ability, loyalty, and devotion to duty of inestimable value and I feel that his service to the Government in the position of First Assistant Secretary of the Interior will be of the same high quality. Aside from other considerations, I believe his advancement will be a deserved recognition of the merit system in our Federal service."

Mr. Burlew was born December 27, 1885, at Sunbury, Pa. After an academic education his early experience was in railroad, banking, and publication work. Through competitive civil-service examination, he entered the Government service in 1910 as a clerk in the War Department and was transferred to the Post Office Department in 1914 as a clerk in the Postal Savings System. Later he was selected for promotion to the position of private secretary to the Third Assistant Postmaster General, Alexander M. Dockery, which position he held for 5 years under the administration of President Woodrow Wilson.

Subsequently, he served as confidential clerk to Postmaster General Will H. Hays, through Mr. Hays' incumbency, and then as private secretary to Postmaster General Hubert Work.

When Dr. Work was designated to take over the Secretaryship of the Department of the Interior on March 5, 1923, he brought Mr. Burlew with him as Administrative Assistant, which position he has held under Secretaries West, Wilbur, and Ickes. In addition, he has served as budget officer for the Department.

While a member of the bar of the District of Columbia and admitted to practice before the United States Supreme Court, Mr. Burlew has not actively engaged in the practice of law. He is a recognized authority on Government procedure and has been a student and leader in the conservation movement over the entire period of his connection with the Department of the Interior.

Mr. Burlew's wife is Mrs. Lydia C. Burlew, and they have a son, Dr. John S. Burlew, of the Geophysical Laboratories of the Carnegie Institute.

The position of First Assistant Secretary of the Interior was left vacant by the death of Theodore Augustus Walters on November 27, 1937.

PRICE
ONE
DOLLAR
A YEAR

THE RECLAMATION ERA

VOLUME 28 • APRIL 1938 • NUMBER 4

MUSEUM

United States Department of the Interior

By MISS MAE A. SCHNURR, *Chief of Public Relations*

THIS article is designed to take you on a tour of our new Museum, open to the public on March 9. The Museum is a permanent feature of the new building and lends itself to change from time to time. The exhibits as they are at present set up include more than 1,000 specimens, nearly 500 special photographs, 250 charts and maps, 100 models, 12 large wall maps, hand colored and illustrated, 11 dioramas, 8 murals, and nearly 1,500 hand lettered labels describing the various exhibits. This material is housed in 95 cases in one wing off the main corridor on the first floor of the building, and covers 11,750 square feet of floor space. The drawing with this article will show the location of the exhibits of the various offices.

In brief, the different office exhibits show the following:

Office of the Secretary

A tablet entitled "Back of the Buffalo Seal" describes the functions of the Department of the Interior. The Buffalo Seal shown above, is the official insignia of the Department of the Interior. Depicted also is the organization chart of the Department showing the delegation of authority of the Secretary to his various assistants and the assignment of the bureaus and officers under these assistants.

General Land Office

Students of history will be pleased with the display of priceless historic documents bearing the signatures of LaFayette, John Quincy Adams, Andrew Jackson, Ulysses S. Grant, and Robert E. Lee. This bureau, one of the oldest agencies in the Federal Government, dates back to 1812 when it was established as a bureau in the Treasury Department, and tells its story with original documents, striking paintings and models. Here you will find an originai land grant of 10,000 acres in Florida, bearing the signature of King George III, and the heavy wax seal of the British Government. The grant was made in 1776 to James Baird. Subsequent documents bearing signatures of American officials show the part played by historic figures in the early land development program when it was the custom to issue warrants for land as bounty in reward for meritorious military service. The first grant of land for the establishment of a transcontinental railroad is shown, as well as a grant to the Illinois Central, the first railroad to receive a grant of public land in the United States.

A striking diorama, symbolic of the early "land rush" days, is displayed, showing colorful figures typical of the early days when public lands were thrown open to entry.

Grazing on the public domain is shown by an attractive lifelike diorama.

Office of Indian Affairs

Progress and welfare of the American Indian during the past 100 years is reenacted in the Indian exhibit. Their industries are shown by rugs, baskets, blankets, beadwork, silver jewelry, native pottery, paintings, etc. One case houses a 3-foot high burden basket, closely woven with bird design, which was made on the Papago Reservation in Arizona. This is flanked by a 1-inch specimen made by the Pima Indians of Arizona.

The scope and extent of the numerous Indian reservations, administered by the Office of Indian Affairs, are shown on a large map which is the starting point of the visitor's tour of the Indian exhibit. Early trading-post days are shown in a diorama depicting Indians bargaining with fur traders.

The original Indian citizenship law, approved by President Coolidge on June 2, 1924, is included among the historic documents.

Improvement of living conditions among Indians is illustrated by homes ranging from wigwams to modern houses. Different types of wearing apparel are shown in a collection of dolls.

Office of Education

This agency of the Federal Government has, since 1867, served as a clearing house and research center for all phases of educational activity. By pictures, maps, and graphs, the extent of the educational system of the United States is shown; also how the Federal Office of Education, under the Interior Department, acts as consultant. This service, taking the form of redistribution of educational information, extends also to foreign educational institutions.

Advancement of vocational education in the field of industry, agriculture, and homemaking, is portrayed in interesting, illustrated legends, and maps showing the spread of this branch of educational work.

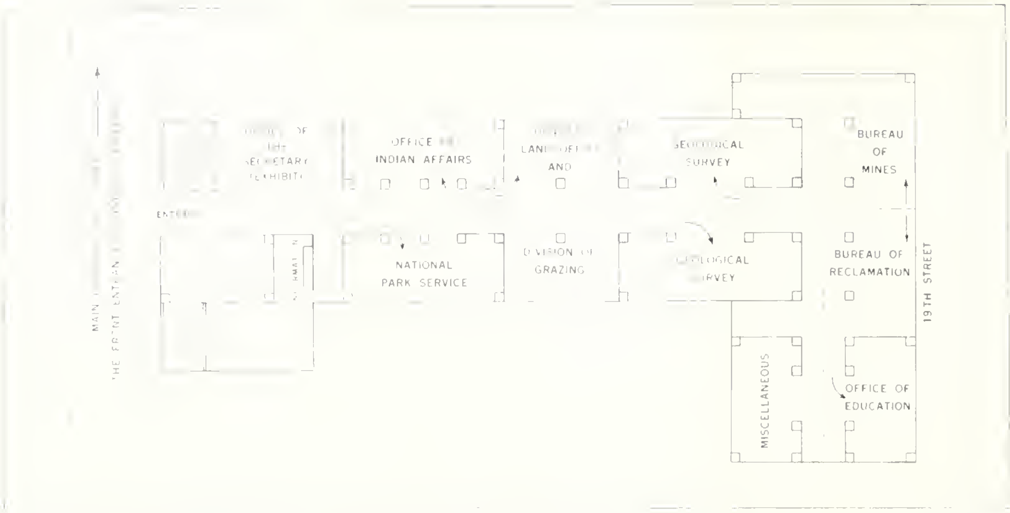
Geological Survey

One of the most attractive exhibits, showing 2 billion years of geologic development, is strikingly portrayed in this bureau's exhibit. A spiral calendar, flanked by specimens of geological formations and fossils of plants and animals which flourished in pre-historic days, traces the march of time through countless eras. Two billion years is the period of known written history, and is represented by a small fraction of an inch on the large spiral.

Kettleman Hills North Dome Oil Field in California and stream-gaging operations are shown by dioramas, and aerial photography, map-making, surveying, and other activities of this bureau covering more than half a century in conservation of natural resources, are outlined in pictures and with the help of the written labels are made interesting and understandable.

Bureau of Reclamation

Our own exhibit is made up of photographs, maps, models, specimens, and lifelike dioramas. You can usually find the crowds around the realistic model of Boulder Dam, glass encased, and showing, by means of transparent film inserted in the wall on either side, the Colorado River Drainage Basin, and Boulder Dam, made



Plan of Interior Museum.

one-half transparent to show the inner workings of the structure, respectively.

Two interesting large wall maps, one showing the various dams constructed by the Bureau and the other the principal crops grown on the various projects, attract concentration and study. The dams are painted in natural colors, showing types, and the crops are miniature cut-out models, such as tiny heads of lettuce, bunches of asparagus, grapefruit, and oranges, and the highly specialized crops that portray the importance of the Federal reclamation policy as it affects the American dinner table.

A large transparency, encased in glass, and lighted from the rear, of the Roosevelt Dam on the Salt River project in Arizona, comes in for its share of admiration.

Early irrigation methods of the Indians as contrasted to present-day methods are shown in a display case by means of paintings. Another case shows the organization of the Bureau, its past heads, and scenes of operations of the various service units of the Bureau, such as engineering, operation and maintenance, legal, accounting, public relations, etc.

National Park Service

This bureau, established in 1916, centers its exhibit around a diorama which reenacts the episode in 1870, which was the birth of the national park idea and led to the establishment of the Yellowstone National Park as the first reservation for conservation of natural beauty under the Federal Government. The scene is a glowing campfire, very realistic, including the burning embers and the tiny figures gathered around. Cornelius Hedges, one of the group depicted in this historic reproduction, suggested a national park area rather than the filing of land claims which would have brought riches from the Yellowstone area to the claimants. From this small start has grown the present-day system of 142 reservations of scenic or historic value, which are visited annually by approximately 15,000,000 people. The exhibit also includes transparencies, specimens of Sequoia cones, petrified wood, stalactites and stalagmites from caverns, and a large painting of the Grand Canyon and Great Falls of the Yellowstone.

As the National Park Service not only has under its supervision the national parks, but also the historic reservations, this exhibit is made colorful by diminutive figures representing likenesses of early pioneer types, ski jumpers picturing winter sports in the parks, and also restoration work in the national military parks. Outstanding among the dioramas is one depicting the meeting in 1780 between Gen. George Washington and the Marquis de LaFayette at the Ford Mansion, Headquarters of the Revolutionary forces at Morristown, N. J., now in a national historical park administered by the National Park Service.

Bureau of Mines

A very excellent diorama, representing a major mine disaster, draws your attention to the exhibit of this Bureau. Then, by a series of specimens, you are made familiar with the various classes of ore. The research work and experimentation of the Bureau, during the past 25 years, are explained by placards and photographs. A cross-section model of a modern telephone instrument uniquely shows the use of metals in everyday life. Specimens of silica, mica, nickel, zinc, talc, lead, cobalt, iron, gold, silver, magnesium, aluminum, copper, asphalt, and tin are grouped around the instrument and clearly labeled to show the part they play in the construction of the instrument. Bureau's activity in the field of safety is portrayed covering equipment to prevent accidents, and illustrates services rendered in solving problems of ventilation, furnace operation and detection of gas leaks.

We owe to the Bureau of Mines the discovery of valuable deposits of potash in New Mexico and Texas, which, before the war, had to be imported from abroad. Potash is valuable for agricultural fertilizer.

Public Works Administration

Two cases contain photographs and descriptions of typical structures built with Government funds to relieve unemployment. A map carries the slogan "off relief rolls on to pay rolls."

Puerto Rico Reconstruction Administration

The successful results of this organization in its work in Puerto Rico are shown by photographs and descriptive labels.

Division of Territories and Island Possessions

Photographs and works of arts and crafts are used to give a bird's-eye view of Hawaii, Alaska, Virgin Islands, and Puerto Rico.

Miscellaneous

St. Elizabeths Hospital, Columbia Institution for the Deaf, Freedman's Hospital, and Howard University portray the work of these institutions by paintings, photographs, charts and graphs, liberally covered by explanatory labels.

The Division of Motion Pictures and the Division of Information, operating as offices under the Secretary of the Interior, also show their activities by photographs and labels.

Those visitors who desire to have further information about the activities of any individual bureau, may secure printed material at an information desk inside the entrance to the Museum, shown on the Museum layout.

The Museum, as at present developed, is the cumulation of 3 years' effort to assemble a comprehensive picture of activities ranging over 90 years of existence, and covering nine bureaus and offices in the department participating in the displays.

We hope visitors from out of town will remember to visit this Museum. It is open week days from 9 a. m. to 4:30 p. m.

Miss Schnurr Addresses Women's Club

MISS MAE A. SCHNURR, Chief of Public Relations, Bureau of Reclamation, addressed the women of our foreign service at a regular monthly luncheon in Washington at noon on April 6, her subject being "The History of Irrigated Agriculture in the United States, and the Operation of the Federal Reclamation Policy." The address was illustrated with colored lantern slides. Following her talk the Boulder Dam film was shown.

Miss Schnurr's address was one of a series of six planned for the season. The foreign service women had previously heard Miss Lenroot, of the Department of Labor; Dr. O'Day, Representative from New York in the National Legislature; Miss. Aiken, of the Department of Justice; and Mrs. Franklin D. Roosevelt.

The sixth and last address will be given next month by Mrs. Ruth B. Shipley, Chief of the Passport Division of the State Department.

Findings of Repayment Commission

A REPORT was submitted on March 25 to Secretary of the Interior Harold L. Ickes, showing that $1,454,822 had been collected from water users of Federal Reclamation projects as repayments due for the year 1937 on the cost of construction of project works.

By that date the last of the recommendations by the Repayment Commission dealing with requests by irrigation districts for relief of all or parts of their 1937 payments had been acted upon by the Department. Collection of $300,331, which otherwise would have been due for the year 1937, had been postponed upon recommendation of the Repayment Commission. Involved were parts or all of the charges from 11 projects or units of projects, which the Commission found in need of relief.

Remaining due and payable for the year 1937 after the extensions had been granted was a total of $2,823,180. Under some of the contracts with project water users the final payment due for the preceding year does not become payable until June 1 of the following year. Payments for last year which have not yet become due and payable under these contracts total $720,653.

It is expected that some water users' organizations, which had delayed making their payments until the Repayment Commission had acted on their requests for relief, will send the money in shortly now that the Commission has completed this phase of its work.

The Repayment Commission was created by the act of August 21, 1937, and was assigned the duty, among others, of determining and recommending to the Secretary, what, if any, relief should be granted the water users of Federal and Indian irrigation projects for the year 1937. It was required to base its findings on investigations designed to determine the actual economic conditions of the projects, and to recommend relief only when the payments would impose great hardship or undue burdens upon the water users.

The Commission held hearings in 24 western towns and heard evidence presented by 78 separate irrigation districts. It traveled 10,500 miles in making its investigations.

Summarized briefly, the relief granted upon the Commission's recommendations follows:

Minidoka project, Gravity division.—Extension of all charges in excess of $2.50 an acre.

Yakima project, Sunnyside Valley.—Extension of 50 percent of the charges on Warren Act lands.

Umatilla project, West Extension and Hermiston Districts.—Extension of 100 percent of the 1937 charges.

Milk River project, Malta division.—Extension of 50 percent of the 1937 charges; Glasgow division, extension of 75 percent of the 1937 charges.

Belle Fourche project.—Extension of 70 percent of the 1937 charges.

Okanogan project.—Extension of 50 percent of the 1937 charges.

Minidoka project, Milner-Gooding division.—Extension of 50 percent of the 1937 charges.

Uncompahgre project.—Extension of 50 percent of the 1937 charges.

Klamath project, Horsefly and Langell Valley Irrigation Districts, and the Klamath Drainage District.—Extension of 50 percent of the 1937 charges.

Newlands project.—Extension of 50 percent of the 1937 charges.

Yuma project, Bard division.—Extension of 50 percent of the 1937 charges on 6 of about 200 units.

The principal reason given by the Commission for difficulties experienced in these areas in making relief necessary was the general low prices received for farm products during 1937. Sums affected in the extensions were postponed so that they will become due during the year following the last regular payment under the present contract.

The Commission recommended that no extensions for the year be granted to the following divisions of the Yakima project: Granger, Grandview, Prosser, Outlook, Snipes Mountain, and Tieton; to the Valley division of the Yuma project; to the Garland division of the Shoshone project; to the Westland and Stanfield divisions of the Umatilla project; nor to the Lower Yellowstone project.

No action was taken by the Commission with respect to requests for relief from the Gem District of the Owyhee project and the Bitter Root project, since special conditions rendered the relief act not applicable to them or their problems.

Members of the Commission are Dr. Charles A. Lory, Fort Collins, Colo., chairman; George T. Cochran, of La Grande, Oreg.; and William R. Wallace, of Salt Lake City, Utah.

The Commission still is in session working on the second phase of its work, a general report with recommendations on the repayment methods.

Progress of Investigations of Projects

THE following is a brief summary of the work during the month of February:

California, Kings River-Pine Flat project.—Analysis of records of past use of water along Kings River was continued.

Colorado, Blue River transmountain diversion.—Geological examinations were made of Waterton, Leal, and Dillon dam sites; designs and estimates prepared; and study of power uses in electro-metallurgy of ores begun in cooperation with Colorado School of Mines.

Colorado-Big Thompson transmountain diversion—Financial study of the entire power system was begun.

Colorado, Eastern Slope surveys.—Field investigations of Smoky Hill project were completed and reports of Cherry Creek, Apishaga, North Republican River, and Trinidad projects in preparation.

Colorado, Western Slope surveys.—Studies were continued of the Collbran, Florida, La Plata, Mancos, Paonia, and Silt projects, and report completed of the West Divide project.

Idaho, Cabinet Gorge project.—Diamond drilling at the Cabinet Gorge site, and study of power market were continued.

Southwest Idaho investigations.—Data for the preparation of reports on the Boise, Payette, Salmon, and Weiser watersheds were assembled.

Nebraska.—It is planned to make a field study of the Bostwick project, and a report on the Mirage Flats project is nearly completed.

North Dakota.—Studies for power requirements for pumping on the Buford-Trenton project were completed and a report is in preparation; reviews of reports of the Bowman, Heart Butte, and Missouri River diversion projects are in progress.

Oklahoma.—The report of the Altus project is in press, and a report of the Kenton project is in preparation.

Oregon.—Studies were in progress for alternate plans for the Canby project, and surveys were continued of the Grande Ronde project, a general map prepared and preparation of report begun.

South Dakota.—Studies of runoff records of Cheyenne and Belle Fourche Rivers were continued and a report of the Shadehill project is in course of preparation.

Utah.—Diamond drilling at the Scofield dam, Price River investigations, was in progress, and water supply studies of Gooseberry project continued.

Utah-Idaho-Wyoming.—Field work in Utah and Wyoming was in progress for securing data for the aerial mosaic of the Bear River Valley for the Green River-Bear River project.

Orland Oil Possibilities

INTEREST in oil possibilities in the vicinity of the Orland project continues, and according to one of the local papers, four oil companies have been considering the starting drilling operations within 90 days. The wells, if drilled, would be located 10 to 12 miles south of Orland.

Unity Dam Construction, Burnt River Project

THE Burnt River project, of which Unity Dam is the principal feature, is located in central eastern Oregon. The project was authorized under the Emergency Relief Act of 1935, and an allotment of $500,000 was made available in August 1935. A repayment contract was entered into between the United States and the Burnt River Irrigation District on December 24, 1935. This original contract, calling for a maximum expenditure of $550,000, was amended by the addition of a supplementary contract dated October 2, 1937, increasing the liability to a maximum of $600,060.

Burnt River and tributaries are typical mountain streams, with sufficient annual run-off to adequately irrigate the available lands, if the flash spring run-off is stored, but sadly deficient, if dependent on the natural flow. The discharge at the dam site varies from a maximum of 1,450 second-feet in flood stage to a minimum of 10 second-feet during the months of July and August. As there are some 9,000 acres irrigated below the reservoir, storage is a necessity, if the land is to remain in cultivation.

Investigation on the possibility of storage on Burnt River was made by the Bureau in 1933, under a cooperative agreement with the State of Oregon. The project as constructed follows the plan outlined in the report of the 1933 investigation. The dam, located at the lower end of Unity Valley, creates a reservoir of 25,120 acre-feet capacity, with an area of 917 acres. This storage will give to the lands below the reservoir a full water supply, and add an estimated 4,000 acre-foot supply to the lands above the reservoir, by allowing them the entire natural flow, which previously passed on down the river to satisfy prior rights.

The bids for the construction of the dam were opened in Vale, Oreg., on November 30, 1935. There were 10 bidders, with J. A. Terteling & Sons, of Boise, Idaho, the low bidder. Award of the contract was delayed pending further investigation, which revealed a more satisfactory site approximately 2,000 feet upstream from the first location. An order for change dated June 25, 1936, was issued for the construction of the dam at the new site. The notice to proceed was acknowledged July 30, 1936, and construction started August 13, 1936. The work under the contract was completed January 4, 1938, approximately 6 months ahead of schedule.

Unity Dam, built by the Bureau of Reclamation to conserve the water of Burnt River. This earth-fill structure, faced with rock, is 78 feet high and will store 25,260 acre-feet of water to supplement the irrigation supply of about 9,000 acres on the new Burnt River Federal reclamation project, and through regulation of the run-off indirectly benefit an equal acreage in Unity Valley, Oregon.

Highway Completed

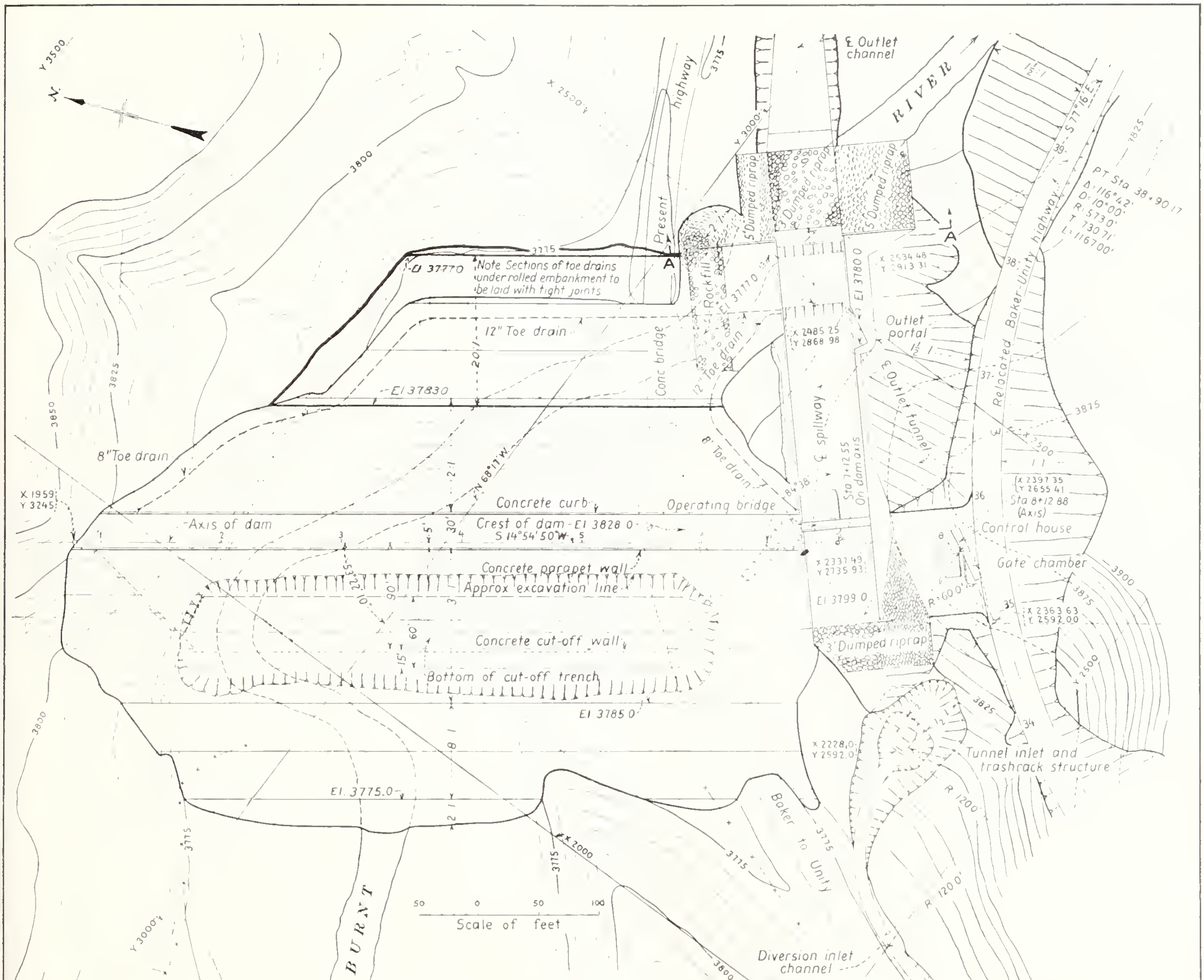
Owing to the fact that the Baker-Unity Highway (State No. 7) was situated in the bottom of the canyon at the dam site, it was necessary to relocate approximately 1 mile of the highway, and to construct a concrete bridge across the river below the dam. A contract was negotiated with the State Highway Commission, whereby the Government would locate and construct the new highway in accordance with State specifications, and the Highway Department would design the bridge. As a result of this contract, the Government opened bids for the construction of the highway, at Unity, Oreg., on April 1, 1937. Eleven bids were received. The contract was awarded to the low bidder, the George B. Henly Construction Co., of Ontario, Oreg. Notice to proceed was acknowledged on June 5, 1937, and the work completed in October 1937.

The Government, under the terms of the contracts for the dam and highway, agreed to furnish concrete aggregate at the site of the work. The contract for furnishing this material was awarded to Chester T. Lackey, of Ontario, Oreg. The aggregate was secured from a deposit approximately 4,000 feet upstream from the dam. Because of the deficiency in fines in the local sand, the contract provided for the delivery of blending sand from the Lackey Commercial pit at Ontario, approximately 90 miles from the dam site.

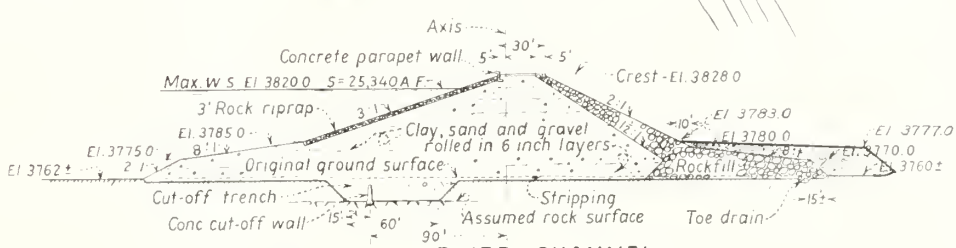
Since the dam is approximately 45 miles from the nearest town having living quarters and office space available, it was necessary to build a complete camp, to take care of the entire engineering force and their families. This camp was located in Unity, a small village having a school, post office, and two stores, and located 5 miles from the dam site.

Dam and Appurtenant Works

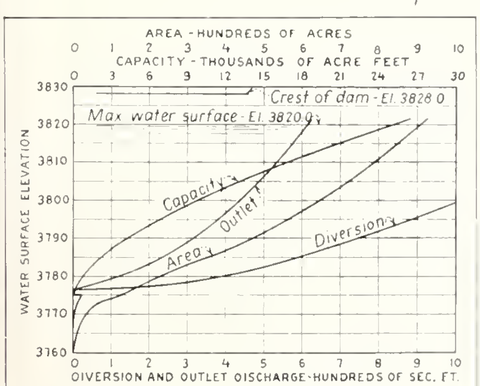
The main embankment consists of a rolled earthfill section, having a 3-foot layer of dumped riprap on the upstream slope, a large section of rockfill on the downstream slope, and a cut-off trench to bedrock under the upstream toe. The dam has a crest elevation of 3,828, a width of 30 feet, a length of 694 feet at the crest, a maximum height of 83 feet, and a maximum distance of 425 feet between the upstream and downstream toes. The maximum water surface elevation is 3,820.



GENERAL PLAN



SECTION IN RIVER CHANNEL



AREA-CAPACITY-DISCHARGE CURVES

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
BURNT RIVER PROJECT - OREGON

UNITY DAM - GENERAL PLAN AND SECTIONS

SITE NUMBER 5

The upstream slope is constructed on a 3 : 1 slope from the crest to elevation 3,785, with 3 feet of dumped riprap placed over this area. Below elevation 3,785, the cofferdam, which was constructed as a part of the dam section, was constructed on an 8 : 1 slope to elevation 3,775. The downstream slope of the earthfill section is constructed on a $1\frac{1}{2}$: 1 slope, from a distance of 20 feet downstream from the axis to elevation 3,772.4, at which point, it meets the rockfill section, and is constructed on a 1 : 1 slope toward the axis, to the foundation. The rockfill section on the downstream is constructed on a 2 : 1 slope to elevation 3,783, thence on a 20 : 1 slope to elevation 3,777, and from there slopes to meet the natural ground, with a gradual slope toward the outlet channel to insure drainage. Toe drains were constructed 15 feet inside the downstream toe, and up both abutments.

A cut-off trench, having a bottom width of 60 feet and 1 : 1 side slopes, was excavated to bedrock under the upstream portion of the dam. A concrete cut-off wall was constructed in the trench, 90 feet upstream from the axis of the dam, and 45 feet from the downstream toe of the cut-off trench. The wall having a maximum height of 10 feet, not including the footing, which was placed a depth of 3 feet into sound rock, extends completely across the river bed parallel to the axis, and then angles up the slopes of the abutment on the north to a point above highwater, and joins the spillway gate structure cut-off wall on the south.

A grout curtain was placed in the bottom of the cut-off trench completely across the dam section. Grout under high pressure was forced into the foundation through drill holes, having a maximum depth of 50 feet. The holes were drilled along the cut-off wall at an average of 12.5-foot centers, with only the alternate holes drilled to the 50-foot depth.

Spillway

The spillway, located at the south abutment, is a concrete-lined structure having automatically controlled radial gates, and a maximum capacity of 10,000 cubic feet per second. The concrete section is 336 feet long and 55.5 feet in width. The gate structure contains two 24- by 16-foot automatically controlled radial gates, in addition to emergency hoisting apparatus. The stilling basin, located at the lower end of the spillway, is 65 feet long and 31 feet deep. It provides a 10-foot water cushion, supplemented by a toothed apron and dentated sill at the upper and lower ends of the pool, to slow up the velocity of the water leaving the pool. The structure sets entirely on bedrock. Below the gate structure, the spillway is provided with a drainage system under the floor and the foundation was grouted to insure satisfactory foundation conditions.

Outlet Works

The outlet works consist of a concrete lined tunnel, trashrack intake structure, gate chamber, stairway shaft, and control house. All parts of the outlet works are constructed in or set on bedrock. The tunnel outlet discharges into the spillway stilling basin.

The trashrack is a standard rectangular structure having openings on three sides and the top, and is joined to the tunnel by a 10-foot transition from a square to a circle. The openings are covered with steel bars set on 6-inch centers. The tunnel is a $7\frac{1}{2}$-foot inside diameter circular section, having a minimum concrete thickness of 8 inches. The total length is 364 feet, and it was designed to provide 1,000 second-feet of discharge at reservoir elevation 3,800, prior to installation of the gates. The outlet discharge capacity, after installation of the gates, is 610 second-feet at full reservoir. The discharge through the outlet is controlled by two sets of 2 feet 9 inches by 2 feet 9 inches hydraulically operated high-pressure slide gates set in tandem in the gate chamber.

The control house is situated at the top of the spiral stairway shaft, leading from the gate chamber over the tunnel. It is a concrete structure 13 by 20 feet, with French tile roof. It contains the high-pressure oil pump for operating the gates, the control valves and operating mechanism, a 3-kilowatt motor generator set, and the mercury gage for indicating the reservoir level.

The tunnel was grouted, first under low pressure to fill the voids between the concrete and the surrounding rock, and then under high pressure through holes drilled 15 feet into the rock, to insure sealing of any seams or fissures in the surrounding rock.

Quantities in the Dam

The completed structure contains 205,967 cubic yards of embankment, 4,666 cubic yards of concrete, 463,479 pounds of reinforcement steel, 45,312 cubic yards of rock in riprap and rockfill, 197,139 pounds of structural steel, gates and miscellaneous metal work, and 6,084 cubic feet of grout.

Embankment

The earth embankment material was secured from dam excavation and two borrow pits. The bulk of the material came from a bench on the north rim of the reservoir, approximately 2,500 feet from the dam. This material was very impervious, with approximately 5 percent oversize. Moisture was introduced in the pit by dyking and flooding. Hauling was by caterpillar tractors pulling 12-yard carry-all units in tandem. Rolling was done with tractor-drawn sheeps-foot rollers.

For the upstream and downstream slopes, a more pervious material, stable under saturated conditions, was secured from cut-off excavation and from a gravelly deposit on the bench approximately 2,500 feet southwest of the embankment. This material was loaded into trucks by a ¾-yard shovel. Moisture was introduced by sprinkling on the fill.

The downstream rockfill came from spillway excavation. As this material was not considered suitable for upstream riprap, the amount of rockfill at the downstream toe was increased to make use of all the required excavation. The riprap for the upstream slope was secured from a talus slide of hard dense basalt, situated near the top of a ridge forming the south abutment of the dam.

Concrete Operations

The bulk of the concrete was mixed at a central mixing plant located upstream from the tunnel intake. Transportation was by pump, through 6-inch pipe lines laid to the various concrete structures. The aggregates were stock piled above the weighing hoppers, which were thus fed by gravity. The weighing hoppers dumped into a batching hopper, where cement was added, and this hopper dumped directly into the mixer. The mixer in turn discharged into the pump.

Concrete for the cut-off wall and part of the radial gate section was mixed at the site, and wheeled into place with buggies. Internal vibrators were used at all times.

Highway

The relocation of the highway referred to above, involved the excavation of 61,857 cubic yards of material, the placing of 196 cubic yards of concrete, 44,100 pounds of structural steel, 26,747 pounds of reinforcement steel, 388 linear feet of corrugated metal pipe, and 11.3 M feet board measure of treated timber.

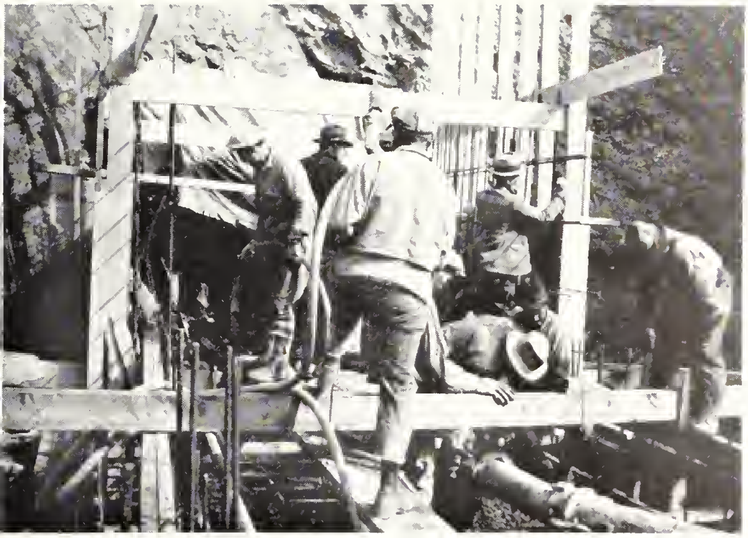
Excavation was by ¾-yard shovel and tractor-drawn carry-all units. Hauling was by trucks and carry-all. The bulk of the excavation was in cuts adjacent to the south abutment of the dam. This material was used in two large fills, one adjacent to the dam, and the other approximately 2,500 feet from the dam, where the highway crosses an arm of the reservoir.

Miscellaneous

Clearing of the reservoir was done by a small crew of CCC forces. Approximately one-fourth of the reservoir area was covered with a dense growth of willows. These willows grew along the stream and in swamps, so that difficulty was experienced in getting at them. Some were pulled with tractors, but probably one-half were cut by hand. The piling and burning of the willows involved as much labor as the cutting.

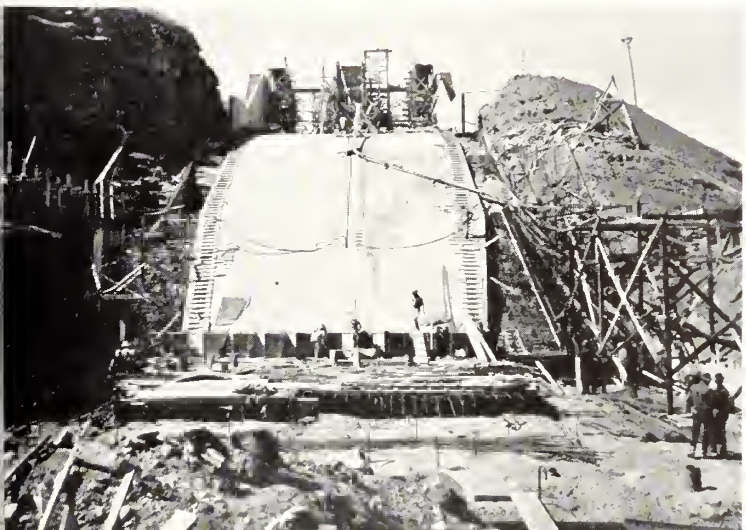
The parapet and curb walls were omitted from the contract for the dam. It is planned to construct masonry walls, with CCC labor, during the summer of 1938. Other future work planned for CCC forces include the installation of emergency radial gate hoists, landscaping of the grounds in the vicinity of the dam, and the moving of one of the cottages from the Unity camp, for a gatekeeper's cottage.

The total cost of the dam and related works will be approximately $600,000.



Dam site and clearing operations.

Construction operations.



Chute section of spillway.

Ten-day progress view of earth fill.

Spillway inlet, tunnel inlet, and control house.

Upstream view of completed dam.

The Accident Prevention Program of the Bureau of Reclamation

DURING the year 1936 nearly 11,000,000 citizens of the United States were injured in some kind of an accident; of this number 111,000 were killed, 400,000 were permanently disabled, and the cost to the American people was $3,700,000,000. Incomplete returns for 1937 indicate an increase over these figures. That this appalling loss of life and limb, and the tremendous cost incidental thereto, has become a matter of public concern is evidenced by increasing efforts toward the control and prevention of accidents in all phases of private and industrial pursuits. These efforts are reflected in the location and design of highways, in regulations concerning the operation of public carriers, in manufacturing processes and products, in mining and quarrying, on the farm and in nearly every other activity of modern life.

Steering Committees in Action

Recognizing a need for greater effort toward the prevention of accidents in Government operations, the President of the United States, in December of 1935, directed the Secretary of Labor to hold a conference of various department executives to consider ways and means of approaching the problem. Following up this start, he later directed the various department heads to prepare programs of health and safety for each major subdivision under their direction—these suggested programs to be presented to a previously authorized steering committee. In accordance with the recommendation of this committee, the President on March 10, 1937, directed the Secretary of Labor to organize an Interdepartmental Safety Council, which organization was effected on June 18, 1937. George O. Sanford, General Supervisor of Operation and Maintenance of the Bureau of Reclamation, Frank L. Ahern of the National Park Service, and Paul L. Fickinger of the Office of Indian Affairs, were appointed by the Secretary of the Interior as members of the Interdepartmental Safety Council and directed to prepare a program of health and safety for these three agencies of the Department of the Interior. This report was prepared and submitted to the Steering Committee, and was later published. Mr. Sanford, in addition to representing the Bureau of Reclamation on the Interdepartmental Safety Council, has general supervision over the Bureau's safety program.

Reclamation Safety Program

In June of 1937, Engineer Louis R. Douglass was transferred from the Designing Section of the Denver Office to the newly established Safety Section, to assume both general and detailed charge of the safety program. This new section will be responsible for the collection and analysis of statistical data relative to accidents occurring on Bureau of Reclamation projects; for the dissemination of statistical and educational information relative to prevention methods; and for the direction and supervision of corresponding activities on the various projects. A publication, the "Reclamation Safety Record" is issued monthly by this section as a means of publishing data of general interest and value pertinent to the safety program.

As no problem can be intelligently solved until its elements are defined, one of the first steps taken in connection with the safety program was the institution of a system of reporting accidents. Monthly accident reports showing cause, classification, severity, and costs are required of each project. These reports are reviewed in the Denver Office, and a monthly consolidated report prepared, which provides comparison and analysis of the accident experience on each of the projects and for the Bureau as a whole. The following is a summary of these consolidated accident reports for the 4 months from September 1 to December 31, 1937, inclusive. The monthly average of Bureau of Reclamation employees during this period was 4,997. This group worked a total of 3,839,340 man-hours and sustained 121 injuries involving lost time beyond the day or shift during which the injury occurred. The total amount of this lost time was 1,984 days. The resulting frequency rate (number of injuries per million man-hours worked) was 31.52, and the severity rate (total days lost per 1,000 man-hours worked) was 0.52. The monthly average of contractors' employees, on the various projects, during the same period was 11,967, with an exposure of 8,267,370 man-hours. A total of 867 lost-time accidents, including 14 fatalities, were sustained by this group; the total lost-time charges were 104,336 days, and the corresponding frequency and severity rates, 104.9 and 12.62, respectively.

Analyses of the causes of these accidents do not appear to support the natural assumption that the accident rates for various projects, when compared, should reflect the relative hazards. Certain projects whose features involve less inherent hazards show a less favorable accident record than do others where the character of the work would seem to warrant a greater accident expectancy. Also a remarkably small percentage of these accidents result from the lack of mechanical or similar safeguards, the majority apparently being due to individual acts of carelessness or the lack of proper direction and control of construction methods and incidental operations.

The Bureau's program does not contemplate the assumption of the contractor's responsibility for the control and prevention of accidents on contract work; the objective is to actuate him in the establishment of safe methods and practices, to actively cooperate in their institution, and in the promotion of safety education. On projects operated and maintained by the Bureau the accomplishment of these objectives is a direct responsibility.

Safety Measures

Mr. Douglass has visited practically all of the projects of the Bureau of Reclamation since assuming his new duties. The purpose of these visits has been threefold: To consult with the Bureau's supervisory personnel and with the contractors or their representatives on the general problem and method of attack; to inspect the workings with the view to pointing out specific hazards; and to assist in organizing an accident prevention program on each project. Ordinarily some member of the Bureau's project organization has been designated as project safety engineer, or safety inspector—usually in connection with his other duties, although on a few of the larger projects the safety work is handled by a "full-time" man. These project safety men are given the responsibility of putting required safety measures into effect and promoting safety education.

This last, safety education, is the fundamental feature of a successful accident prevention program. Accidents result not so much because of the nature of the work, as from carelessness and thoughtlessness. Supervisors and workmen alike must be taught to realize that accidents can be prevented by a reasonable amount of forethought. Safe methods are demanded by the thoughtful supervisor; unsafe conditions are recognized by the thoughtful foreman; and safe practices are habitual with the thoughtful workman.

Contrary to general belief, accident prevention reduces rather than increases the cost of the work. Construction projects, or other industrial operations with high accident records invariably show relatively higher production costs. It will probably never be possible to completely eliminate accidents on construction projects because of the inherently hazardous nature of the work, but continued efforts can and will bring about a major reduction in their frequency and severity.

Pumping Plants Operated on Reclamation Projects During Fiscal Year 1936-37

Project	Name of plant	Type of units	Plant capacity: Horsepower	Plant capacity: Second-feet	Number of units	Static lift (feet)	First cost of plant	Cost of operation and maintenance	Estimated depreciation	Energy used for pumping, kilowatt-hours	Acre-feet pumped	Cost per acre-foot without depreciation: Per acre-foot	Cost per acre-foot without depreciation: Per foot lift
Belle Fourche	Johnson Lateral	G. E. D. C	125	10	1	45	$4,960.32	$1,659.17	$300.00		800	$2.07	$0.046
Boise	Black Canyon	V. T. D. S	1,244	300	2	28.5	149,901.39	807.81			106,203	.0076	.00027
Grand Valley	Price—Stub	V. T. D. C	125	28	1	31	46,697.83	471.30	1,000.00		6,485	.0726	.00234
Huntley	Ballantine Auxiliary	O. E. D. C	400	32	2	43.5	71,103.56	4,378.39	3,500.00		2,606	1.68	.0386
	Hydraulic	V. T. D. C	620	66	2	43.5	73,883.32	2,347.96	(1)		15,829	.1483	.00341
Klamath	Dry Lake No. 1	do	75	19.3	1	51	31,861.11	100.00	1,200.00	1,950	540	.1852	.0036
	Dry Lake No. 2	V. M. D. C	100	15.4	1	44.8	8,366.73	1,780.00	400.00	195,250	3,000	.5933	.01324
	Melhase-Ryan Sump Drainage	V. M. D. S	50	19.5	2	14.4	6,300.00	658.94	300.00	58,360	1,860	.3543	.0246
	Tule Lake No. 1	do	60	25	1	Av., 4.6	[2] 34,804.00	543.06	[2] 1,750.00	38,870	3,023	.1796	.0392
	Tule Lake No. 2	do	25	12	1	4.5	[2] 34,804.00	280.44	[2] 1,750.00	22,907	1,293	.2169	.0480
	Tule Lake No. 3	V. M. D. C	120	50	2	7.1	[2] 34,804.00	2,017.02	[2] 1,750.00	255,600	15,324	.1316	.0185
	Tule Lake No. 4	V. M. D. S	150	50	2	7.3	11,890.00	2,580.92	600.00	343,200	18,699	.1380	.0190
	Tule Lake No. 5	do	180	91	3	8.1	17,859.00	3,724.77	900.00	498,200	27,667	.1346	.0167
	Tule Lake No. 6	do	50	25	1	6.8	[3] 10,020.88	394.30		43,040	3,280	.1202	.0176
Lower Yellowstone	Thomas Point	H. T. D. C	220	45	2	31	49,970.43	914.84	1,000.00	None	10,539	.087	.0028
Minidoka	First Lift	V. M. D. C	[4] 5,110	1,035	6	28.63	258,977.79	(5)		12,885,169	262,466		
	Second Lift	do	[4] 3,925	828	5	Av., 30.08	226,432.40	(5)		11,627,700	212,962		
	Third Lift	do	[4] 2,600	520	3	Av., 29.35	137,359.05	(5)		6,925,130	140,180		
	A-4 Raise	Scoop wheel	25	20	1	3.5	3,328.43	(6)		40,910	[7] 4,371		
	C-2 Raise	do	15	14	1	2.5	(8)	(6)		45,118	[7] 4,680		
	D-4 Drain Pumps	V. M. D. C	100	25	2	19	(8)	(6)		[9] 205,500	[7] [9] 5,991		
	D-15 Drain Pumps	do	140	37.5	3	16	(8)	(6)		280,539	[7] 8,794		
	Boersch Lake Drainage Pumps	do	200	50	2	20	32,947.72	(6) (10)		596,000	17,902		
	Canal 20 Pump	do	150	25	1		(8)	(6)		257,000	[7] 5,354		
	Carter Drain Pump	do	40	10	1	21	(8)	(6)		(11)	(11)		
	114 Pumping Plant	H. M. D. C	10	4	1	7	2,803.97	(6)		11,820	[7] 615		
	1812 Pumping Plant	do	7.5	2	1	4	1,008.76	(6)		16,308	[7] 485		
	1817 Raise	Scoop wheel	15	11	1	4.8	3,634.71	(6)		17,520	[7] 3,650		
	McRae Drain Pump	H. M. D. C	7.5	2	1	14	864.77	(6)		13,298	[7] 396		
	Paul Sugar Factory Drain Pumps	V. M. D. C	100	25	2	19	(8)	(6)		103,048	[7] 3,067		
	Rural Line Pumps	H. M. D. C	30	10	2	14	(8)	(6)		75,520	[7] 2,360		
	South Side Drainage Pumps	3-H. M. D. C., 2-V. M. D. C	70	23.4	5	8-16	19,725.44	(6)		202,320	[7] 8,430		
	West End Pumping Plant	H. M. D. C	150	40	2	21.25	18,741.61	(6)		447,140	9,191		
	10 Small Pumps	H. M. D. C., V. M. D. C	87.5		10		(8)	(6)		108,092			
Newlands	Lahontan Swingle Bench	H. M. D. C	400	70	2	70	21,336.37	340.13	1,241.04	40,400	605	.56	.008
	Lee (L Drain)	V. M. D. C	7.5	2	1	6	100.43	30.15	5.00	170	28	1.08	.18
	Viera	V. M. D. S	5	2	1	8	1,092.13	121.42	54.61	2,147	170	.81	.10
	Wood-Scrimsher	do	10	2	1	10.74	1,248.18	430.13	62.41	13,229	270	1.60	.15
North Platte	Dutch Flats Drainage [12]	V. M. D. C	70	8	3	30-52	23,393.94	None	None	None	None		
Okanogan	Duck Lake	H. M. D. C	100	11	2	50-80	18,400.00	2,692.32			1,440	1.87	.031
	Robinson Flat	do	275	10	2	188	30,077.24	4,878.55			1,703	2.86	.015
Owyhee	Advancement	do	70	18.5	2	18.1-26	6,636.47	(13)		183,680	4,041		
	Dead Ox	do	2,675	176	5	50.5-111	109,700.00	769.00		2,041,480	13,990	.055	.0002
Rio Grande	Mesa Drain	do	75	45	3	5-8	17,981.38	4,750.51	180.00	190,640	12,990	.365	.058
Salt River	Chandler Division	V. M. D. C. and S	1,095	81	10	54	192,379.94	27,701.20	13,466.60	2,382,692	17,285	1.60261	.02968
	Laveen Division	do	470	50	7	48	51,708.70	16,813.27	3,619.61	1,228,092	13,905	1.20914	.02519
	Mesa Division	do	3,915	188	30	102	399,839.90	136,884.34	27,988.79	12,053,564	61,345	2.2313	.02187
	Phoenix Division	do	3,195	129	59	83	389,591.36	84,631.26	27,271.40	6,147,037	35,815	2.36245	.02846
	Salt River Division	do	2,125	134	32	64	250,060.27	52,226.00	17,504.42	4,044,347	33,044	1.58049	.0247
	Tempe Division	V. T. D. C	3,050	247	29	58	171,164.20	81,249.56	11,981.49	6,609,485	55,953	1.4251	.02504
	Highline	H. M. D. C	950	105	4	50	66,656.83	42,665.79	4,665.98	3,736,642	36,230	1.17763	.02355
	Joint Head	V. M. D. C	300	100	2	20	23,000.00	8,314.33	1,610.00	753,649	19,741	.42117	.02106
	Maricopa Garden Farm	do	75	11	1	37	12,930.92	4,275.74	905.16	302,046	4,257	1.0044	.02715
	Booster Pump at 15th Avenue	H. M. D. C	8	4	1	8	1,000.00	212.84	70.00	3,408	(14)		
	Booster Pump at 13¼E-12⅞N	do	5	2	1	5	781.00	(15)	54.67	(15)			
	Booster Pump at 17¼E-9½N	do	5	g. p. m., 100	1	12	1,113.16	466.24	77.92	4,726	(14)		
	Booster Pump at 22E-1½S	do	150	16	1	20	6,245.00	3,498.43	437.15	317,106	(14)		
	Booster Pump at 23E-10¾N	V. M. D. S	15	7.5	1	5	971.57	238.35	68.00	19,428	(14)		
	Booster Pump at 23½E-10¾N	do	20	7.5	1	6.5	1,398.00	359.81	97.86	26,168	(14)		
	Booster Pump at 24E-10½N	do	20	5.3	1	7	1,650.00	172.96	115.50	13,603	(14)		
	Booster Pump at 27½E-4N	H. M. D. C	50	6	1	8	2,650.00	131.43	185.50	1,863	(14)		
Yakima:													
Kittitas Division	Wippel	H. T. D. C	1,000	50	2	124.9	78,798.00	1,073.91	None	None	10,086	.1065	.0009
Sunnyside Division	Snipes Mountain	V. T. D. C	850	22	3	200	78,000.00	2,935.93	1,890.00	None	6,958	.422	.0021
	Outlook	do	800	48	2	110	92,000.00	1,321.87	2,480.00	None	17,218	.077	.0007
	Grandview	1-V. T. D. C., 2-H. T. D. C	365	38	3	35, 78	72,500.00	1,989.70	2,120.00	None	12,430	.16	.0025
	Hillcrest	V. T. D. C	35	1.56	1	103	5,800.00	253.00	328.00	None	328	.771	.0075
	Little Snipes Mountain	H. T. D. C	5	1/3	1	50	1,065.00	140.16	68.71	None	117	1.20	.024
	Prosser	do	190	12	1	105	31,968.00	750.14	1,500.00	None	3,729	.201	.0019
	Spring Creek	do	160	11.6	1	90	28,056.00	790.00	1,500.00	None	3,821	.207	.0023
Yuma	California Drain	1-G. E. D. C., 1-G. E. G. C	130	56	2	1.68	6,775.00	180.40	338.00	[16] 225	82.9	2.18	1.29
	Valley Drainage	1-O. E. D. S., 2-H. M. D. S	275/525	130/300	3	Av., 10.344	169,270.07	10,659.70	5,970.00	[17] 2,700 949,500	46,174	.231	.022
	West Yuma	H. M. G. C	20	2.36	1	4	1,040.00	95.84	72.00	7,965	103	.929	.232
Yuma Auxiliary	"B" Lift	1-V. M. D. C., 2-H. M. D. C	1,100	105	3	71.8	165,204.32	10,446.28	5,520.00	1,402,000	10,613	.984	.0137

[1] Plant depreciated. [2] Plants No. 1, 2, and 3. [3] To date, plant placed in operation April 24, 1937. [4] Actual imput. [5] Operated by Burley Irrigation District. [6] Operated by Minidoka Irrigation District, see Boerch Lake pumping plant. [7] Estimated. [8] Built and operated by Minidoka Irrigation District. [9] Includes Carter Drain. [10] Cost of operating all Minidoka Irrigation District Pumps from November 1, 1935, to October 31, 1936, was $16,717.05. [11] See D-4 Drain Pumps. [12] Not operated during fiscal year 1936-37 account of drought conditions. [13] Pumps are small and automatic, requiring attention by ditch rider once a day. No cost of operation and maintenance kept. [14] No record. [15] Not operated. [16] Gallons of gasoline. [17] Gallons of oil.

TYPE PUMP:

V. M. D. C.=Vertical motor-driven centrifugal pump. H. M. D. C.=Horizontal motor-driven centrifugal pump. V. T. D. C.=Vertical hydraulic turbine-driven centrifugal pump. H. T. D. C.=Horizontal hydraulic turbine-driven centrifugal pump. H. M. D. C.=Horizontal gear connected motor-driven centrifugal pump. O. E. D. C.=Oil engine-driven centrifugal pump. G. E. D. C.=Gas engine-driven centrifugal pump. G. E. G. C.=Gas engine gear-driven centrifugal pump. V. T. D. S.=Vertical hydraulic turbine-driven screw pump. V. M. D. S.=Vertical motor-driven screw pump. O. E. D. S.=Oil engine-driven horizontal screw pump. H. M. D. S.=Horizontal motor-driven screw pump.

The Salton Sea in Imperial Valley

TO passengers on the sunset route of the Southern Pacific Railroad through Southern California, as well as to automobile tourists traveling United States Highway No. 99, the immense lake known as the Salton Sea is an object of much interest. It is located in the State and in the northern part of Imperial County. It is about 45 miles north of the Mexican border and 150 miles southeast of Los Angeles. Transcontinental passengers on Southern Pacific trains follow its northeastern shoreline for about 30 miles and travelers in automobiles a similar distance on its opposite side.

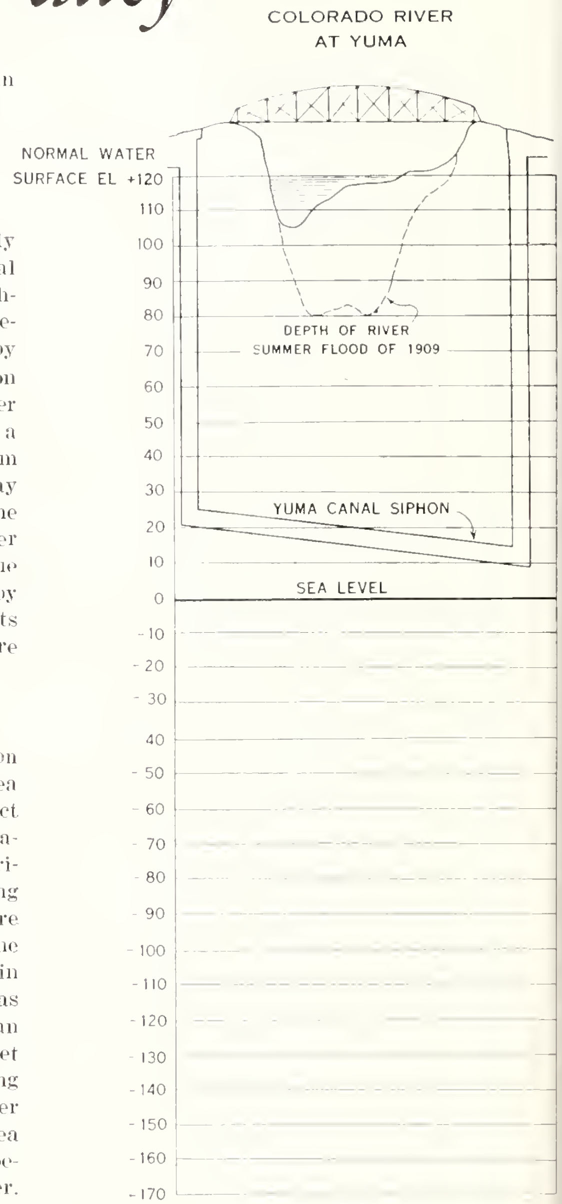
In January 1938, the water surface of the Sea was 246.4 feet below sea level and its maximum depth 26½ feet. Its area was 289 square miles, or approximately 180,000 acres, and its longest dimension, in a northwestwardly southeastwardly direction, about 32 miles with maximum widths of 8 and 13½ miles. It is the lowest part of Imperial Valley and with the exception of Death Valley, also in California, which is 276 feet below sea level, it is the lowest point in the United States.

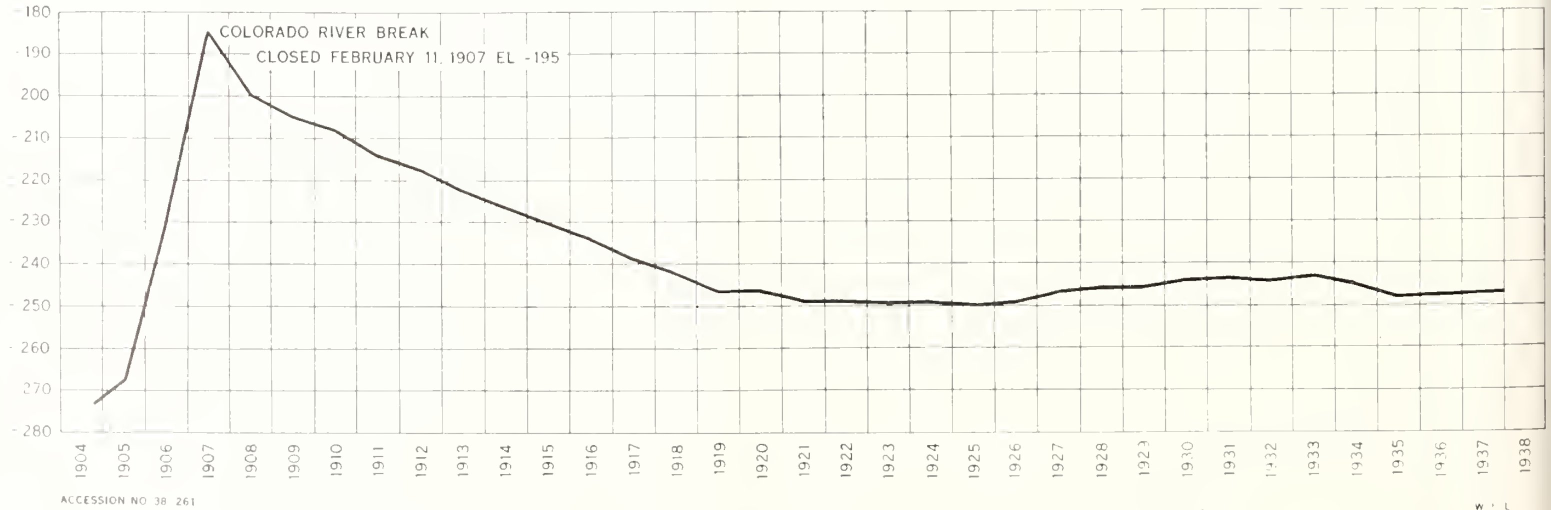
The Salton Sea came into national prominence in 1905 when the Colorado River broke its banks a short distance below the international boundary line west of Yuma and for 15 months flowed through the Alamo and New Rivers into the Sea, threatening the destruction of much valuable property, both farming and city. Closure of the river break was accomplished in February 1907, after arduous and expensive work. During the period of inflow from the Colorado River, the water level raised 60 feet, and the Sea attained a maximum depth of 78½ feet with a maximum elevation of 195 feet below sea level. It is estimated that some 22,000,000 acre-feet of water from the Colorado River were discharged into the Sea during the 1905–7 break.

The present Salton Sea began to form in November 1904, due largely to irrigation operations in Imperial Valley that were initiated about this time. In earlier times it was known as Lake Cahuilla, named after the tribe of Cahuilla Indians. The Gulf of California originally extended north into what is now Imperial Valley, and the lake area occupied the northwestern part of what was once the Gulf, being that portion cut off from the Sea by Colorado River delta deposits. The Salton Sea as a result of the 1905 Colorado River break attained a length of 45 miles with a maximum width of 17 miles. It extended from Niland almost to Mecca, submerged railway stations, and necessitated the removal of some 67 miles of Southern Pacific tracks to higher ground. A bed of salt on the shore of the original lake at Salton had been exploited by the New Liverpool Salt Co. and shipments made for many years, but the works were destroyed by the 1905 river break.

Utilization of Salton Sea

The rate of evaporation less rainfall on the Sea is about 7 feet per year. The Sea is utilized by the Imperial Irrigation District as an outlet for drainage and surplus irrigation water from one-half million acres of irrigable lands included in the district. Following the closure of the river break in 1907, there was a gradual decline in the water level of the Sea to elevation 250.7 feet below sea level in November 1924, since which time the level has fluctuated through a range slightly less than 8 feet to a maximum elevation of 242.9 feet below sea level recorded in May 1931. During the drought year of 1934 and extreme water supply shortage in Imperial Valley, the Sea receded 4 feet from an elevation 244 feet below sea level in March to 248.0 in December.





ELEVATION OF WATER SURFACE OF SALTON SEA 1904–1938
IMPERIAL AND RIVERSIDE COUNTIES, CALIFORNIA

Mullet Island, located about 1 mile east of Salton Sea, is the center of boiling springs, miniature geysers, and mud pots, together with pigment beds of variegated colors. It is believed that these made their appearance in 1916 concurrently with the eruption of Volcano Lake in Mexico, some 60 miles to the south. The island was practically submerged by the Salton Sea during the Colorado River break, but since the recession of the Sea has lost its island identity and now rises above the surrounding land. Its summit is elevation 189 feet below sea level.

A few miles east of Salton Sea and Mullet Island, there has been developed in recent years a new industry, that of manufacturing dry ice. Carbonic gas, 99 percent pure, is obtained from wells at depths varying from 750 to 1,000 feet. A plant treats the gas by condensation into liquid and ice form for the market.

Rainfall Near Salton Sea

THE rainfall at Indio, a town near the northern end of Salton Sea, ranges over a long period of years from a trace in 1894 to a maximum of 7.87 inches in 1927, with an average of about 3 inches per year.

Salinity of Salton Sea

THE salinity of the Salton Sea, and other noted bodies of salt water are given in parts per million and percent as follows:

Bodies of water	Parts per 1,000,000	Percentage of salinity
Colorado River at Yuma	696	0. 075
Salton Sea 1907	3, 554	. 355
Salton Sea 1913	9, 700	. 97
Caspian Sea	12, 940	1. 29
Ocean water	35, 190	3. 52
Great Salt Lake	195, 580	19. 56
Dead Sea	222, 834	22. 28

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Government Seeks to Intervene in Suit Nebraska vs. Wyoming

THE petition by the Government filed in the Supreme Court early in April to intervene in a suit between Nebraska and Wyoming is an effort to protect the interests of water users and of the United States on Federal reclamation projects, according to a statement by Secretary of the Interior Harold L. Ickes.

"Some State interests have inquired whether a change of Federal policy is involved in the motion to intervene," Secretary Ickes said. "State water laws will be followed by the Federal Government in the future as in the past."

The suit in which the Government seeks to intervene is for an equitable apportionment of the waters of the North Platte River between Nebraska and Wyoming. Colorado was made a party to the suit by Wyoming.

For the purpose of showing its right to intervene, the Government's motion to the Supreme Court contends that the users of the North Platte River waters have acquired title to their water from the United States and that the United States now owns any waters of that river which have not yet been appropriated. The Government's contention is that the United States owns the unappropriated waters of nonnavigable streams.

Secretary Ickes emphasized, however, that Congress regularly has disposed of these Federally owned waters under the various State laws. The Congress so provided in its Acts of 1866, 1870, and 1877. The Reclamation Act of 1902 contains a directory provision that the Secretary of the Interior in administering the Federal Reclamation Law shall proceed in conformity with State water laws. Secretary Ickes assured western State interests that neither the Department of the Interior nor the Bureau of Reclamation is proposing or has any desire for a change in the Reclamation Act.

The Secretary pointed to the long history of cooperation between States and the Federal Government in the development of the Federal reclamation projects and said: "That tradition has been found fundamentally necessary to the reclamation development in the West, and it is essential to continuation of this work. It will be upheld."

"For nearly all practical purposes it is and has been immaterial as to where the basic title to the waters rests," Secretary Ickes said. "In an occasional instance like the suit between Nebraska and Wyoming it is important that the United States assert its basic title to show its right to protect the water supply of the farmers on the reclamation projects. In the hearings already held in this suit it has appeared that neither Wyoming nor Nebraska will defend the interstate diversions of water made by the United States in Wyoming for use on the Nebraska lands of the North Platte project.

"In such a situation the Federal Government cannot stand idly by when the security of its project water users and the enormous property interests of the Government in projects will be affected by the suit."

The Government's motion to intervene in the suit between Nebraska and Wyoming is in the interest of the farms and farmers on the Federal projects in those States as well as in the Government's interests.

Annual Pilgrimage of Salt River Water Users to Bartlett Dam

ON February 17 the water users of the Salt River project again made their annual pilgrimage to Bartlett Dam on the Verde River. The group included the board of governors, council members, and officials of the Water Users' Association about 140 persons in all.

Substantial progress has been made in the construction of the dam since their visit a year ago. The Bartlett Dam is of the multiple arch type with a maximum height of 290 feet. The low part of the foundation is about 95 feet below river level. Excellent progress is now being made in construction by the Barrett, Hilp & Macco Corporation. The principal buttresses, arches, and foundation grouting are advanced to a point where little damage can be caused by floods.

The Bartlett Reservoir will have a capacity of about 200,000 acre-feet. In operation it will function in conjunction with storage at Roosevelt Dam on the Salt River. Storage released from Bartlett will flow down the Verde to Salt River, where it will be diverted to the project canals.

The large group of water users were happy to observe the progress that is being made and are hopeful that this additional storage will solve their water problems. The dam is a complicated structure and is scheduled for completion in May 1939. Many of the water users climbed all over the structure and asked numerous questions.

Water users visit Bartlett Dam.

A most excellent feed was served at the contractor's mess. Lin B. Orme, genial toastmaster, saw to it that everybody had a good time. Short talks were made by Messrs. Orme, president; A. C. Huber, vice president; J. H. Dobson, and T. J. Hughes of the association; and E. C. Koppen, construction engineer, for the Bureau.

Contract Made for Purchase of Firm Power From Boulder Dam

THE Secretary of the Interior Harold L. Ickes has announced completion of a contract with the Citizens Utility Co., of Minneapolis, Minn., which operates the power system serving Kingman County, Ariz., by which the company may buy 50,000,000 kilowatt-hours annually from the Boulder Dam Power Plant until December 31, 1954.

The company will pay the regular price for firm energy at Boulder Dam, 1.63 mills per kilowatt-hour, and the revenues from the contract, if the maximum allowable is taken, would amount to $81,500 a year. The power being sold is firm power originally contracted for by the metropolitan water district of southern California, which has announced it will be unable to use the energy on the date at which its contract becomes effective, June 1, 1938.

The contract with the Citizens Utility Co. is the second of its type, since on January 28 a similar contract for the sale of a maximum 20,000,000 kilowatt-hours annually of unused metropolitan water district energy was completed with the Needles Gas & Electric Co., of San Francisco, which serves Needles, Calif., and vicinity. This contract also extends to December 31, 1954; requires the payment of 1.63 mills per killowatt-hour and is otherwise similar to that of the Citizens Utility Co. The contract with the Needles Co. would bring a maximum of $32,600 annually into the treasury.

Under a provision in the contract with the metropolitan water district the Secretary of the Interior is empowered to dispose of the unused energy, after first offering it to the city of Los Angeles and other major purchasers who hold options on the unused power.

The revenues received from the sale of power to the Citizens Utility Co. and the Needles Gas & Electric Co. will go into the United States Treasury, but will be credited against the obligation of the Metropolitan Water District, thereby serving to reduce the charges made against the district.

The Metropolitan Water District announced it would be unable to take its allotment of power at the outset because it has been unable to complete its Colorado River aqueduct. This aqueduct extends 250 miles from Parker Dam, 155 miles below Boulder Dam, to 13 cities on the coastal plain in the vicinity of Los Angeles. The district was allotted 36 percent of the power from the plant at Boulder Dam for use in pumping water through its aqueduct. While Boulder Dam was completed more than 2 years ahead of schedule, the aqueduct construction program could not be advanced.

Two 82,500 kilovolt-ampere generators designed to serve the Metropolitan Water District are now being installed at the Boulder Dam plant and are expected to be ready for operation by June 1. The district, under its

NOTES FOR CONTRACTORS

Specifications No.	Project	Bids opened	Work or material	Low bidder		Bid	Terms	Contract awarded
				Name	Address			
1015-D	Owyhee, Oreg.-Idaho	Jan. 26	Structures, South Canal laterals S.C. 0.1 to 5.7 and sublaterals, Succor Creek division.	David A. Richardson	Ontario, Oreg	$16,197.00		Feb. 23
1020-D	Milk River, Mont	Feb. 1	Structural steel and steel castings for highway bridge over spillway at Fresno Dam.	Joseph T. Ryerson & Sons, Inc.	Chicago, Ill.	11,812.00	F. o. b. Chicago	Do.
1022-D	Kendrick, Wyo	Feb. 11	Construction of the Laramie transmission line road to the Seminoe Dam.	M. J. Sears	Denver, Colo.	37,962.50		Mar. 2
1023-D	Boise-Payette, Idaho; Buffalo Rapids, Mont.	Feb. 3	Dragline excavators and dragline buckets.	Bay City Shovels, Inc.	Bay City, Mich.	[1] 22,506.00	F. o. b. Bay City, discount 2 percent.	Do.
1018-D	Buffalo Rapids, Mont	Feb. 4	2 vertical motor-driven pumping units for the Glendive pumping plant.	Worthington Pump & Machinery Corporation.	Harrison, N. J.	37,780.00	F. o. b. Harrison (pumps), f. o. b. Fallon, Mont. (motors).	Mar. 8
1017-D	Kendrick, Wyo	Jan. 28	Electrical conductor and accessories for transmission lines.	Anaconda Wire & Cable Co	New York, N. Y.	[2] 350,701.32	F. o. b. Cheyenne, Wyo., discount 2 percent	Feb. 26
				Aluminum Co. of America	Washington, D. C.	[3] 80,217.67	F. o. b. Massena, N. Y.	Do.
1032-D	Colorado River, Tex	Feb. 9	750,000 barrels of low-heat portland cement in bulk for Marshall Ford Dam.	Longhorn Portland Cement Co.	San Antonio, Tex	[4] 770,800.00	F. o. b. Rutledge, discount, 10 cents per barrel.	
				Trinity Portland Cement Co.	Dallas, Tex	[5] 703,800.00	do	Mar. 2
1026-D	Boulder Canyon, Ariz.-Nev.	Feb. 10	Line hardware and conductor fittings for 230-kilovolt switchyard at Boulder Dam.	General Electric Supply Corporation.	Denver, Colo.	[6] 3,209.11	F. o. b. Boulder City	Feb. 18
				Burndy Engineering Co., Inc.	New York, N. Y.	[7] 279.08	do	Feb. 19
1027-D	do	Feb. 14	Carrier-current telephone apparatus for Boulder power plant.	General Electric Co	Schenectady, N. Y.	10,090.00	F. o. b. Boulder City	Mar. 4
1036-D	do	Feb. 18	Structural steel for 1 bus structure for the Metropolitan Water District switching station at Boulder switchyard.	American Bridge Co	Denver, Colo.	10,550.00	F. o. b. Pittsburgh	Mar. 12
A-38,005-A	Columbia Basin, Wash.	Jan. 24	Thin-wall steel tubing (483,400 pounds).	Steel & Tubes Inc.	Cleveland, Ohio	46,637.50	F. o. b. Odair, discount 5 percent.	Mar. 2
A-38,004-A	do	do	Pipe or tubing (318,832 pounds)	National Electric Products Corporation.	Pittsburgh, Pa	22,435.66	do	Mar. 15
A-38,003-A	do	Jan. 25	Fittings for thin-wall steel tubing	Graybar Electric Co	Denver, Colo.	15,772.57	F. o. b. Elizabeth, N. J., items 1 to 12; f. o. b. Odair, item 3, discount 5 percent.	Mar. 3
770	Yakima-Roza, Wash	Feb. 9	Earthwork, tunnel and canal lining, stations 1591+72, to 1641+15, Yakima Ridge Canal	T. E. Connolly Inc.	San Francisco, Calif.	316,112.40		Mar. 2
769	Shoshone-Heart Mountain, Wyo.	Feb. 10	Earthwork, canal lining and structures, stations 712 to 920, Heart Mountain Canal	Northwestern Engineering Co.	Rapid City, S. Dak.	173,603.70		Mar. 11
767	Central Valley, Calif	Feb. 1	Street, driveway, and sidewalk grading and surfacing, and sewer and water systems for Shasta camp.	Lowrie Paving Co.	San Francisco, Calif.	45,949.55		Mar. 2
752	Columbia Basin, Wash.	Feb. 9	Bulkhead gates for turbine draft tubes at Grand Coulee power plant.	Mississippi Valley Structural Steel Co.	St. Louis, Mo.	34,545.00	F. o. b. St. Louis	Mar. 8
40,733-A	Upper Snake River Storage, Idaho-Wyo.	Feb. 15	5,200 barrels of standard portland cement in cloth sacks.	Union Portland Cement Co	Denver, Colo.	[1] 11,700.00	F. o. b. Devils Slide, Utah. Discount and sacks 50 cents per barrel.	Mar. 2
20,718-F	Kendrick, Wyo., Rio Grande, N. Mex.-Tex	do	Three 95-horsepower diesel-engine-powered crawler tractors (2-Kendrick, 1-Rio Grande).	Caterpillar Tractor Co	Peoria, Ill	[9] 28,655.75	F. o. b. Casper, Wyo. and Hatch, N. Mex. Discount $50 each machine.	Mar. 3
24,605-A	Gila, Ariz	Feb. 7	Steel reinforcement bars, 2,771,375 pounds.	Southern States Steel Corporation.	Dallas, Tex	[10] 63,619.46	F. o. b. Blaisdell, Ariz., discount ½ percent.	Do.
1041-D	Boulder Canyon, Ariz.-Nev.	Mar. 1	Structural-steel structures for group A of Metropolitan Water District transformer circuits in Boulder switchyard.	International Derrick & Equipment Co.	Torrance, Calif.	7,260.00	F. o. b. Torrance, discount ½ percent.	Do.
1034-D	Parker Dam, Ariz.-Calif.	Feb. 18	24,000 barrels of low-heat portland cement in bulk for Parker Dam.	Monolith Portland Cement Co.	Los Angeles, Calif	33,120.00	F. o. b. Monolith, Calif.	Mar. 9
1030-D	Boulder Canyon, Ariz.-Nev.	Feb. 17	Pipe, fittings, and valves for units N-5 and N-6, Boulder power plant.	Ohio Injector Co	do	[8] 7,842.22	F. o. b. Wadsworth, Ohio and Pittsburgh, Pa.	Feb. 28
				Crane-O'Fallon Co	Denver, Colo	[11] 23,460.00	F. o. b. Boulder City	Mar. 9
778	Sun River, Mont	Mar. 1	Enlargement of Sun River Slope Canal, stations 535+00 to 1153+24.	Williams and Douglas	Kalispell, Mont	67,150.00		Mar. 14
1028-D	Columbia Basin, Wash.	Feb. 11	200,000 barrels of modified portland cement in bulk.	Lehigh Portland Cement Co	Chicago, Ill	[12] 68,800.00	F. o. b. Metaline, Wash.	Do.
				Spokane Portland Cement Co.	Spokane, Wash	[13] 95,625.00	F. o. b. Irvin, Wash	Do.
				Olympic Portland Cement Co., Inc.	Seattle, Wash	[14] 128,625.00	F. o. b. Bellingham, Wash. All discount 10 cents per barrel.	Do.
768	Provo River, Utah	do	Construction of Deer Creek Dam and railroad and highway relocation.	Rohl-Connolly Co	Los Angeles, Calif	2,189,096.50		Mar. 18
773	Sun River, Mont	Feb. 25	Mill Coulee laterals 26 to 31, and Sun River Slope laterals 71 to 98 and sublaterals.	Dan Teeters & Co	Ogden, Utah	60,108.80		Do.

[1] Items 1 and 2.
[2] Schedules 2 and 3.
[3] Schedules 5 and 8.
[4] 410,000 barrels.
[5] 340,000 barrels.
[6] Schedules 1 to 4, inclusive.
[7] Schedule 5.
[8] Item 1.
[9] Items 1, 2, and 3.
[10] Schedules 1 and 2.
[11] Item 2
[12] 50,000 barrels.
[13] 62,500 barrels.
[14] 87,500 barrels.

contract, is required to pay for such unused energy as is not disposed of otherwise at rates stipulated in the contract.

The Citizens Utility Co. plans to build a transmission line to the power plant to handle its energy. The Government will install transformers and certain other equipment, which the company will pay for at 4 percent interest in 10 years. The company agrees also to pay its proportionate share of the cost of the turbines and generators installed to serve the Metropolitan Water District, these charges to be worked out between the company and the district and to come to the Secretary of the Interior for settlement only in case of disagreement between the two.

The Citizens Utility Co. was not among the original Boulder Dam power purchasers, and its request for power is only one of several unforeseen demands upon the plant capacity.

One-Man Operated Leveler-Float

THE drawing for a oneman operated leveler-float, shown on the opposite page, is from the current slide lecture of the Bureau of Reclamation on the subject "Practical Use of Soil and Water" and is published here so that irrigators desiring to improve their land by leveling and smoothing may have the plan for building this inexpensive farm tool.

Few areas are so smooth that they cannot be improved by grading or leveling. Even in long-established irrigated areas the surface of many fields is too uneven for the proper irrigation of crops. Uneven land means too much water to some plants and too little to others. Unless examination of undersurface conditions indicates porous material such as sand and gravel or shale close to the surface, the land should be leveled so that water can be spread uniformly with a minimum expenditure of time and labor.

While there are many practical machines for leveling and smoothing land, this homemade device will be found an efficient tool on many irrigated farms. As its name implies, only one man is needed to operate both leveler and tractor. This tool is still one-man operated when horses are used, as the depth regulating cable or rope can be brought to the driver's platform with suitable pulleys.

The curved blade is easily loaded and the dirt can be moved a considerable distance from high to low spots.

Water moves uniformly over the smoothed ground surface.

The rollers in the front and rear of the leveler-float are made from logs 14 inches in diameter or drums built up of 2 by 4 lumber. When logs are used, the axles may be made by driving discarded automobile axles about 1¼ inches in diameter into each end of the log for about 12 to 18 inches. When the rollers are drums constructed of lumber, the steel shaft used for the axle should extend the entire length of the roller.

A leveler float with rollers has many advantages over levelers without wheels or rollers. Considerably less draft is required when moving soil from high to low places. The rollers break down lumps of soil and pack the layers of dirt as the soil is being spread.

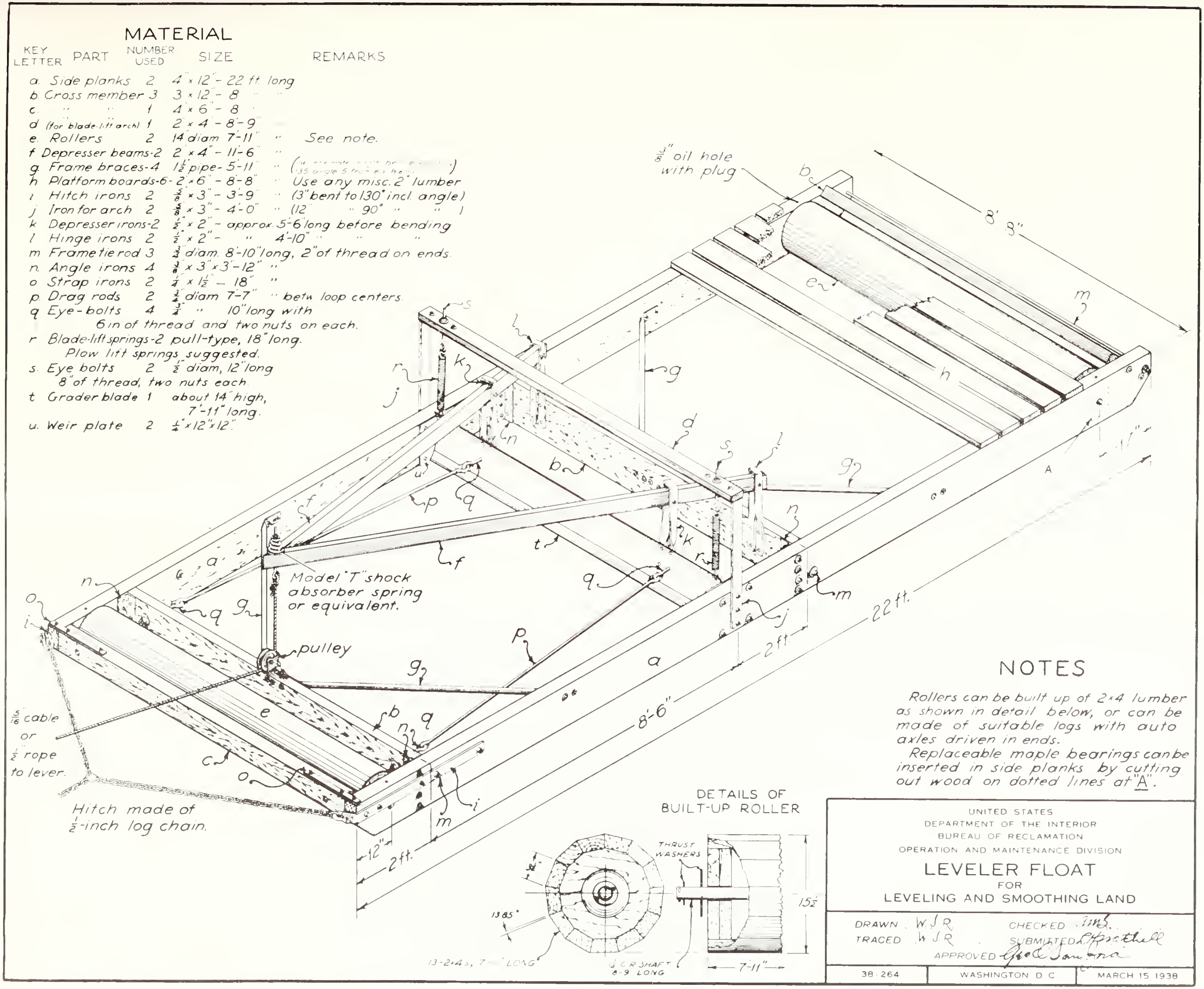
This type of leveler is excellent to level and smooth land to be irrigated by the border or other flooding method. If the ground surface is carefully smoothed, water moves uniformly down the border strips.

The cost of constructing this roller type leveler float varies from $50 to $75 depending upon the local cost of materials and labor. For preparing land to spread water evenly, for packing and smoothing newly plowed fields, and for making a firm seed bed, this simple tool with pay big dividends and is worthy of a careful trial on many irrigated farms.

Other practical homemade tools that should be a part of the equipment on every irrigated farm are shown in the set of slides on the subject Practical Use of Soil and Water. These slides also present in interesting picture and graphic form important information on soil and water management. Among the vital topics covered are efficient methods of irrigation, maintaining, and increasing the fertility of irrigated soils, undersurface soil conditions, the control of leaching and erosion in irrigated areas, the root habits of plants and the application of water to the root zone.

Any interested group may obtain the loan of these slides with the accompanying lecture without cost, except for the payment of express charges, by writing the Commissioner, Bureau of Reclamation, Washington, D. C.

Leveling and smoothing a field with a one-man operated leveler float.


MATERIAL
KEY LETTER | PART | NUMBER USED | SIZE | REMARKS
a. Side planks 2 4"×12" - 22 ft. long
b. Cross member 3 3×12" - 8 "
c. " " 1 4×6" - 8 "
d (for blade-lift arch) 1 2×4 - 8'-9
e. Rollers 2 14"diam 7'-11" " See note.
f Depresser beams-2 2×4" - 11'-6 "
g. Frame braces-4 1½"pipe- 5'-11" "
h Platform boards-6- 2×6" - 8'-8" " Use any misc. 2" lumber
i Hitch irons 2 ⅜×3" - 3'-9" " (3" bent to 130° incl. angle)
j Iron for arch 2 ⅝×3" - 4'-0" " (12" " 90° " ")
k Depresser irons-2 ½"×2" - approx. 5'-6 long before bending
l Hinge irons 2 ½"×2" - " 4'-10" " " "
m Frame tie rod 3 ¾"diam. 8'-10"long, 2" of thread on ends.
n. Angle irons 4 ⅜×3"×3'-12" "
o Strap irons 2 ¼"×1½" - 18" "
p. Drag rods 2 ¾"diam 7'-7" " betw. loop centers.
q Eye-bolts 4 ¾" " 10"long with 6 in of thread and two nuts on each.
r Blade-lift springs-2 pull-type, 18"long. Plow lift springs suggested.
s. Eye bolts 2 ½" diam, 12" long 8" of thread, two nuts each.
t Grader blade 1 about 14" high, 7'-11" long.
u. Weir plate 2 ¼"×12"×12".
⅜" oil hole with plug
8'-8"
Model "T" shock absorber spring or equivalent.
pulley
5/16" cable or ½" rope to lever.
Hitch made of ½-inch log chain.
22 ft.
8'-6"
2 ft.
12"
NOTES
Rollers can be built up of 2×4 lumber as shown in detail below, or can be made of suitable logs with auto axles driven in ends.
Replaceable maple bearings can be inserted in side planks by cutting out wood on dotted lines at "A".
DETAILS OF BUILT-UP ROLLER
THRUST WASHERS
13.85°
15½
7'-11"
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
OPERATION AND MAINTENANCE DIVISION
LEVELER FLOAT
FOR
LEVELING AND SMOOTHING LAND
DRAWN W.J.R.
TRACED W.J.R.
CHECKED
SUBMITTED
APPROVED
38-264
WASHINGTON D.C.
MARCH 15 1938

White Top, Weed Enemy Number One

By H. L. SPENCE, JR., *Extension Agronomist, University of Idaho Extension Service, Moscow, Idaho*

WHITE TOP (Lepidium draba) is one of the most pernicious perennial weeds found in the western United States. While it is exceeded in acreage by several other weeds, yet, in most States, it is considered "weed enemy number 1" among the list of troublesome plants which cause large losses to farmers in this area. Throughout the Rocky Mountain and West Coast States, White Top has completely taken over large areas of fertile soil. Owing to its habit of growth it is extremely difficult to eradicate and grows so abundantly as to smother out crops which are planted on infested lands.

White Top is one of many weed immigrants which have been transplanted from foreign soils through imports of seeds and other commodities. The plant is a native of central Europe and western Asia and sometimes is known as hoary cress, white weed, or Turkestan mustard. Its early history in the United States is somewhat obscure. However, the first infestation which can be definitely traced originated from a lot of alfalfa seed brought east from a California port by wagon freight during the middle of the nineteenth century. The story told is that a freighter reaching a small Utah settlement was faced with financial difficulties and bartered several bags of alfalfa seed in payment of his debts. From these original seedings the weed has spread widely through the West. Doubtless this is but one example of the many infestations brought in through impure seedstocks.

White Top Spreads Rapidly

White Top spreads very rapidly by creeping roots, and small patches may become large within a few years. It seeds very heavily and its seed, besides having a high vitality, may lay in the ground for many years, to germinate and produce plants only when conditions become favorable for germination.

White Top is one of the earliest weeds to start growth in the spring and reaches the bloom and seed stage in most areas by the forepart of June. For this reason first cutting alfalfa infested with White Top usually will contain much mature seed which, when fed to livestock, will further spread the weed through manure and droppings. Water, birds, and machinery likewise have aided in giving this pest a wide distribution throughout the Western States. A number of instances have been noted where isolated uncultivated islands in streams and lakes have become infested with White Top by migrating birds, especially wild ducks.

White Top is a member of the mustard family Cruciferae, of which there are a number of common weeds such as the common pepper grasses and wild radish. The family is characterized by the cruciform flowers composed of four somewhat similar petals abruptly spreading in the form of a cross, and its two-valved seed pod. The flowering branches bear clusters of small white flowers on very slender stems. The whole flower head has a flat-topped appearance. The seeds born in great numbers in two-valved seed pods are dark reddish-brown, flattened, and about the size of alfalfa seed; rounded at one end and narrowed to a point at the other. The root system consists of well-developed large white rootstocks which penetrate to a depth of several feet and spread horizontally in all directions. The plant lives over winter by storing food in the rootstocks which allows it to produce new plants from each root joint the following year. Like other members of the Cruciferae family the plant has a pungent or mustard taste which is readily distinguished.

There are two other closely related plants, equally persistent, and which usually are mistaken for White Top as they often are found growing together. These plants are *Lepidium repens* and *Hymenophysa pubescens.* They can best be distinguished by the shape of the seed pod; *Lepidium draba* having a heart-shaped seed pod, *Lepidium repens* a lens-shaped seed pod, and *Hymenophysa pubescens* a globe-shaped seed pod. In some cases the latter two have been found considerably more difficult to eradicate especially with chemical treatments.

White Top overrunning a ditchbank and adjoining field.

Control and Eradication Measures

The control of White Top is both a difficult and expensive undertaking. Yet land once infested, unless properly cared for, soon becomes unprofitable and greatly reduced in value. A number of methods are used for control and eradication of this weed. However, because of the wide variation in soil and growing conditions it always is wise to seek recommendations from local workers who have had experience in treating this weed, as oftentimes a method which is used in one district or State may prove somewhat less effective in other areas.

In Idaho where large acreages of White Top have been controlled and eradicated, three methods are used with satisfactory results. Cultivation or clean tillage is the oldest known method of eradicating weeds, yet it still plays a most vital part in any well-organized program. Effective chemical methods of weed control still are very limited, and because of the large cash cost, are recommended as practical only for small areas. Large areas in-

fested with White Top can be placed under control and eradicated by continuous cultivation. Such a program requires the land to be taken out of production for at least 2 years and usually cropping to a check-row crop the third year in order that an occasional remaining plant might readily be treated and eradicated. Considerable variation is found in recommendations for a cultivation program, both as to proper tools and the length of time between cultivations. Under Idaho conditions the duckfoot weeder has proven to be the best tool. At present recommendations call for working the infested areas often enough to prevent any growth from emerging through the surface soil. This in most soils usually means an average of every 7 days the first year and somewhat less often the second year, due to weakening of the plants.

Tillage operations should start early in the spring by plowing as deep as possible and then following with the regular cultivations. A second plowing in late July often has proved profitable. Experimental work now under way indicates that longer periods of time between cultivations may be as effective, yet as cultivation simply is a process of starving the plant to death by gradually using up the stored food in the roots and preventing further manufacture of plant food by keeping all top growth removed, the safest criterion is to cultivate often enough to prevent any growth.

Many chemicals have been used in Idaho experimentally, yet only two have proven sufficiently satisfactory for general recommendation. These chemicals, carbon bisulphide and sodium chlorate, are widely used with satisfactory results. *No chemical yet discovered, however, is 100 percent effective under all conditions*, and thorough trials on a small scale should be carried out before heavy investments are made.

Carbon bisulphide is very effective on White Top when used in areas where soil moisture can be controlled. Its use in Idaho is restricted primarily to the irrigated lands. While this material is far more expensive than chlorates, its effectiveness, together with the fact that little or no soil sterility results from its use, makes it desirable, especially for high-priced, productive soils. Complete details on methods of application can be obtained in bulletin form.

Chlorates, in various forms, are widely used as herbicides. In Idaho they have a definite place in the weed program and give satisfactory, although not always uniform, results. Chlorates especially are adapted to use on ditchbanks, roadsides, and other waste areas as under these conditions soil sterilization often is advantageous. The rates of application vary so widely with chlorates that local tests should be made to determine the proper rates of application before being extensively used.

Various arsenicals and other commercially advertised herbicides have not, to date, proven practical under Idaho conditions for the eradication of White Top.

White Top, with its already wide distribution throughout the Western States, threatens the wholesale destruction of large areas of valuable agricultural land. Every farmer should become acquainted with this pest so as to be able to identify it readily, should it appear on his farm. Small areas are easy to eradicate without heavy cost, while if given a chance to establish itself the weed soon spreads and the cost multiplies rapidly. Organized effort is the only means of successful weed programs, and deserves the cooperation of every progressive farmer.

White Top, while only one of a long list of serious weed pests, is a striking example of the damage that pernicious weeds can cause if allowed to go unattended.

Utah Launches Weed Campaign

COUNTY officials, schools, canal companies, and service clubs are being enlisted to carry on a vigorous weed eradication campaign in Utah County, Utah, for 1938. Through these various agencies the general public is to be made weed conscious, so that every available resource may be thrown into the fight to curb noxious plants and to improve crop production.

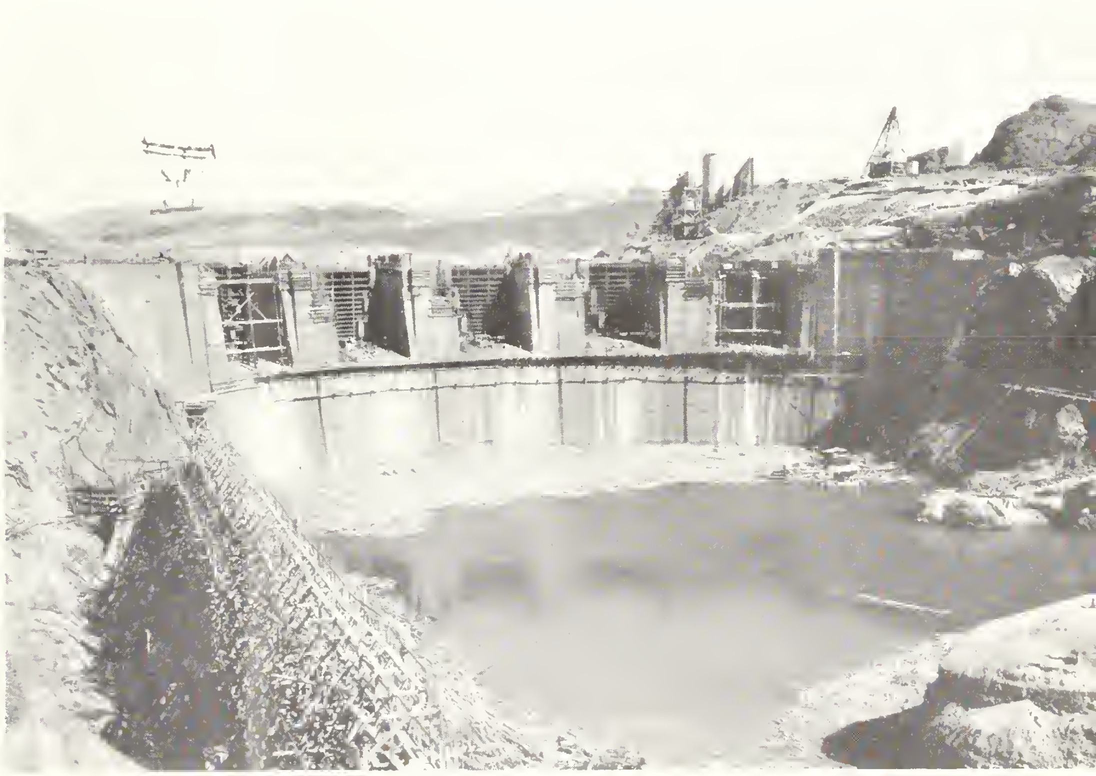
As Utah County is a fruit raising, truck gardening, and diversified agricultural country, and ranks as one of Utah's richest farming areas, importance of the weed drive must be felt by landowners and all other persons to insure greatest success. That was agreed on by more than 40 representatives of different groups at a meeting in Provo.

Beginning January 1, the campaign is to continue all through the year. Not only on farms but on ditch and canal banks, fence lines, highway routes, public lands, and various rights-of-way will the eradication work go on. The schools and public service clubs will conduct an educational campaign, while Utah County, cities, and canal companies will be asked to adopt budgets to help finance the drive. Cooperation by the State weed control committee will be sought in the spray campaign.

The latter method will be jointly financed by State, county, and landowner, each paying one-third of the cost. Utah County will be asked to furnish small plows, tractors, heavy grader blades, gas and oil, machine repairs, wages for operators, two new weed spray machines, and 500 barrels of spray. Utah State will be asked to furnish 500 barrels of chlorate and to pay wages for two supervisors. Signed agreements between Utah County and landowners to insure a 3-year cultivation and weed-spray program is approved as another measure of weed eradication.

Utah County's agricultural extension service, rural leaders, and cooperating organizations are to be complimented upon the campaign they are fostering, which is a sound move in the right direction.—*The Western Farm Life*.

Downstream face of Parker Dam from California side.



CCC Work to Continue on Reclamation Projects

IN order to stay within the reduced funds available for the operation of CCC camps it has been necessary, in recent months, to close a number of camps throughout the United States. Whenever possible, camps which had completed their work programs and had been in operation for a number of years, were selected for termination.

The CCC camps allocated to the Bureau of Reclamation have been engaged in three general classes of work: Rehabilitating completed projects, developing supplemental water supplies, and providing recreational facilities at irrigation reservoirs. The relation of work of this character to the water users living on the projects has not always been fully understood, and the Bureau has been subject to criticism, frequently severe, that our CCC activities tend to benefit the private individual rather than the interests of the general public.

When the work programs for the reclamation camps were first prepared, care was taken to plan the work as that most necessary to the community as a whole. In the rehabilitation of existing distribution systems the CCC work has generally been confined to the principal canals, laterals, and drains. Providing supplemental water to protect lands already under cultivation has assured the continued occupation of farms through periods of droughts, and the development of recreational facilities at irrigation reservoirs for bathing, fishing, boating, and picnicking is a forward step in the effort of the Government to give the reclamation settler and his family an opportunity, near at hand, for rest from his arduous labors.

Recognizing the community value of this work authorization was granted in February to continue CCC work on reclamation projects, subject to the following stipulations:

(a) All work must be performed on federally owned land and must be for the purpose of conserving, safeguarding, improving or developing property in which the Government has a direct financial interest, or for the purpose of providing on the federally owned land recreational facilities for the benefit of the general public.

(b) If the work contemplated is normally financed by water users or local organizations, the CCC operations shall be confined to those projects or subdivisions thereof where, through adversity or other cause the local interests are unable to finance the proposed program.

(c) The task assigned must be suitable for prosecution by the CCC and such as will advance the training and experience of the enrollees.

To protect the Bureau from further criticism, and to insure the proper use of our CCC facilities, the governing requirements cited above will be strictly adhered to in all future CCC operations on reclamation projects.

On February 28, 1938, Hon. Robert Fechner, Director, CCC, formally approved the CCC program for the Department of the Interior for the 6 months period, April 1 to October 1, 1938. Included in this program were a number of changes in the Reclamation camps, required in part by seasonal conditions of climate and in part by the need to conform to the limitations henceforth to govern our CCC program.

It is expected that the conservation activities of the CCC camps on reclamation projects will go forward with renewed effort, now that the clouds surrounding the work in the past have cleared and the path we are to follow is clearly marked. All water users understand the need for this activity and we are grateful that the work can proceed.

Park improvements built by CCC at Leasburg Dam, Rio Grande Project, New Mexico-Texas.

Record Number of Feeder Cattle on Yuma Pastures

NOT only has there been an increase of almost 40 percent in the number of feeder cattle in the Yuma district this winter, as compared with previous years, but the quality of such cattle is said to be the best in history.

Estimates from a reliable source place the number of winter feeder cattle in the valley at 14,000, while it is said that the greatest number previously on winter pasturage here would not greatly exceed 10,000.

The quality of the cattle is believed to reflect the work of cattlemen over a period of years in providing better bulls on the ranges, and in gradually "weeding-out" those varieties of cattle that by long and costly experience have been found to be not profitable.

In the Yuma Valley, this improved quality is found in both the pen and pasture cattle.

The number of sheep on winter pasturage is lower than that of the past year, being placed at 28,000 head as compared with about 33,000 in the winter of 1936–37, with an average over a period of years considerably higher than the current estimate.

Although many of the feeder cattle are owned by Yuma ranchers, the greatest number are on rented pastures.—*Arizona Stockman.*

Reclamation Organization Activities

Commissioner Page Loses Mother

COMMISSIONER PAGE suffered the loss of his mother on March 15. The Commissioner reached her home in Grand Junction, Colo., just before her death and while he was on an official trip to the coast. He attended the funeral services on the 17th.

Mrs. Page, whose death occurred at the age of 78 years, had a tremendous interest in Federal reclamation, having lived in irrigated territory for many years, and naturally she was delighted when her son was appointed by the President to head the Bureau of Reclamation. To within 2 days of her death Mrs. Page was active in church and community affairs.

Dr. Lory in Washington

DR. CHARLES A. LORY, chairman of the Repayment Commission, arrived in Washington on March 9, for a consultation with the Commissioner and members of his staff on matters referring to the Commission's work.

Reclamation Officials in Santa Fe

L. N. McCLELLAN, chief electrical engineer; E. B. Debler, hydraulic engineer; and Porter J. Preston, senior engineer, from Denver, attended on March 17–18 the Conference of Governors in Santa Fe, N. Mex.

John F. Sikes Promoted

JOHN F. SIKES, senior photographer in charge of the photographic laboratory of the Bureau of Reclamation, has been promoted to the position of Assistant to the Chief of the Photographic Section of the Division of Information, Office of the Secretary, under the consolidation of still-picture work. This change became effective on March 1. G. A. Grant, Chief Photographer, was formerly in charge of the photographic laboratory of the National Park Service.

THE following recent personnel changes in the Bureau of Reclamation have been authorized by the Secretary of the Interior:

Appointments

Washington Office:

Marshall T. Jones, associate economic analyst.

Fred Fetter, junior engineering aide, CCC Division.

Columbia Basin project:

Wendell T. Mulkey, assistant engineer.

Denver Office:

Vern H. Thompson, purchasing agent, from assistant purchasing agent, vice Alexander Mc D'Brooks, retired.

Kendrick project:

George Young, supervisor of labor relations, Casper, Wyo.

Transfers

To Denver Office:

Charles A. Engle, engineer, from supervising engineer, Indian Office at Large, Washington, D. C.

Marion W. Archibald, junior engineer, from Upper Snake River project.

Clyde H. Spencer, construction engineer, from Unity, Oreg.

Arthur F. Ormsby, junior clerk, Panama Canal, vice Wilford W. Daynes.

Ernest D. Peterson, junior engineer, from Boise project, Idaho.

To Kendrick project:

George Tarleton, assistant engineer, from Parker Dam, California, to Seminoe Dam near Rawlins, Wyo.

To Buffalo Rapids project:

John D. Officer, inspector, Fort Sumner, N. Mex., to position of junior engineer.

To Central Valley project (Delta division, Antioch, Calif.):

Max R. Johnson, assistant engineer, from the Owyhee project.

Clemount T. Douglass, Jr., associate engineer, from Denver office.

To Milk River project (Fresno Dam):

Elton G. Knight, associate engineer, Salt Lake Basin project, Provo, Utah.

To Yuma project:

Charles B. Elliott, from construction engineer, Uncompahgre project, Montrose, Colo to position of superintendent.

To Provo River project (Deer Creek Dam), Utah, from Salt Lake City:

Ernest O. Larson, engineer; Charles H. Carter, engineer; Leonard R. Dunkley, associate

Marshall Ford Dam. With the exception of blocks 37–41, inclusive, this view, taken from the right abutment, shows progress of all concrete work at the dam. In the immediate foreground two 26-foot diameter conduits to divert the river for the remainder of the construction period may be seen taking form. To the right, excavation and clean-up in preparation for concrete placing are in progress in the spillway apron section. Form work for one spillway apron block may be seen in place. In the background block eight approaches the crest elevation of 670.

engineer; Francis J. Farrell, chief clerk; Cecil B. Jacobson, assistant engineer; and Wilford F. Peterson, junior engineer.

To Kings River, Pine Flat irrigation and flood control secondary project, Calif.:

Harold S. Williams, to associate engineer, from engineer, Friant division, Central Valley project.

Separations

Washington Office:

Miss Alicia L. Brophy, assistant clerk stenographer, to accept employment in California with the San Francisco Exposition.

Denver Office:

Lincoln Reid, junior engineer, to accept offer as instructor in a college in New York City.

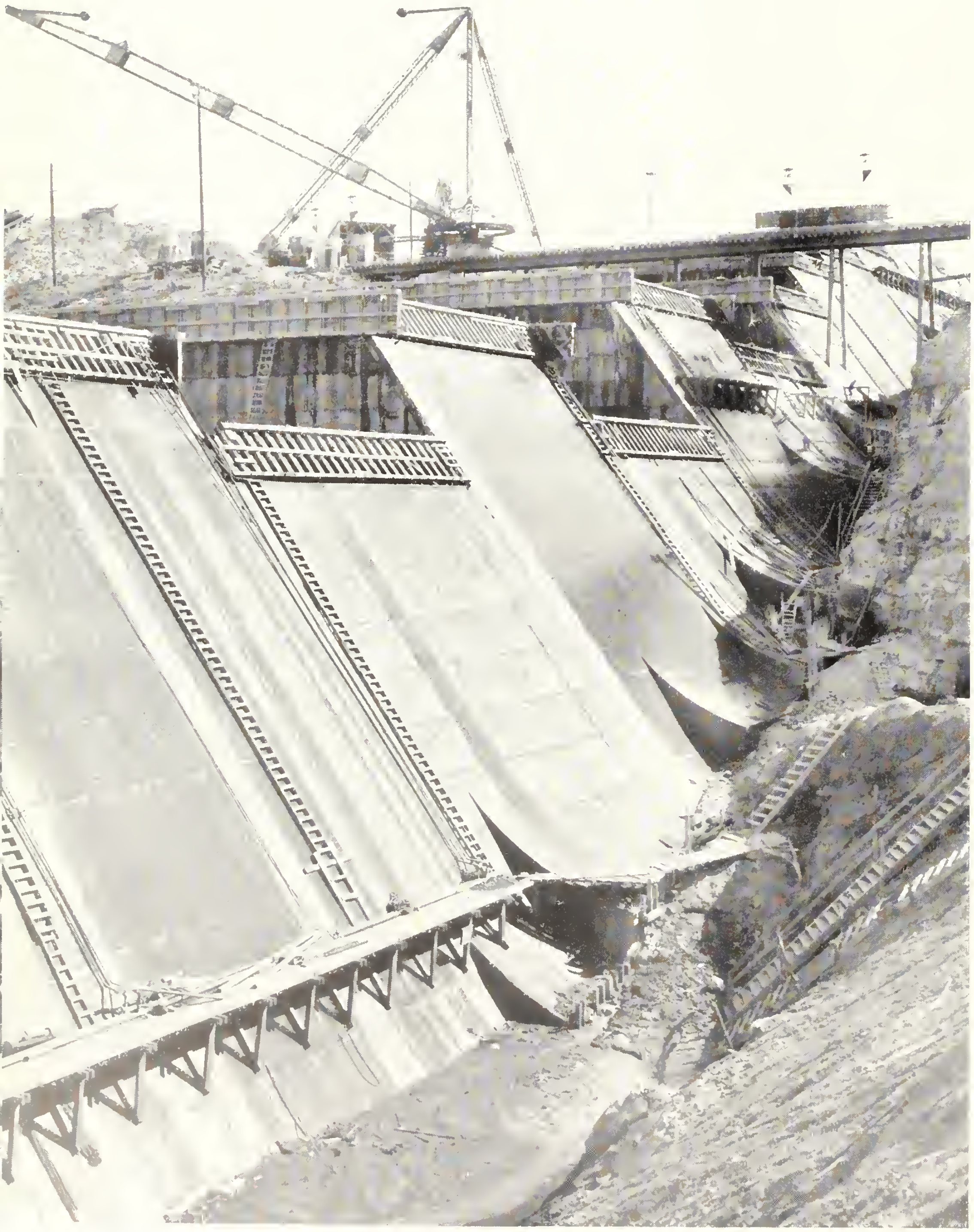
Stewart B. Avery, Jr., junior engineer, to accept employment with the White Mountain Power Co., Plymouth, N. H.

John B. Goodman, assistant engineer.

The following appointments were terminated due to completion of work at Unity Dam, Burnt River project, Oregon:

Stanley E. Kebbe, junior engineer; Russel C. Borden, Richard G. Stacey, and Clemeth C. Neff, inspectors.

The downstream face of Marshall Ford Dam on the Colorado River of Texas, under construction by the Bureau of Reclamation. This straight gravity concrete dam for flood control and water conservation will be 190 feet high.



R. C. E. Weber Resigns

THE RESIGNATION of Mr. Weber, superintendent of the Yuma project, Arizona, has been received, becoming effective March 31.

Mr. Weber has served the Bureau long, faithfully, and efficiently and he will be greatly missed throughout the territory in which he was so well known and admired.

A more detailed notice of Mr. Weber's connections with the Bureau and of his future plans will appear in the next issue of the ERA.

Silt in Black Canyon Reservoir Boise Project

IN a report by the Soil Conservation Service of the Department of Agriculture on the Sedimentation Survey of Black Canyon Reservoir 5 miles northeast of Emmett, Idaho, the amount of silt deposited in 12 years was estimated to be about 4,000 acre-feet. The loss of storage in the reservoir was less than 1 percent a year.

Colonel W. W. Robertson Dies

COLONEL ROBERTSON, publisher and owner of two dailies in Yakima, Washington, and a pioneer in the development of the Yakima Valley for over 40 years, died at St. Elizabeth's Hospital on March 26. His two papers, the Yakima Daily Republic and the Yakima Morning Herald, reflected his personality and brilliant writing.

Colonel Robertson suffered two severe heart attacks on March 22, although he retained his full mental vigor to within 1 hour of his death.

Colonel Robertson was born May 23, 1868, in Blairstown, Iowa, the son of Mr. and Mrs. J. W. Robertson. Both parents were pioneer school teachers with a genuine appreciation of the finest and best in literature. This their son inherited in the fullest degree. His strong character and wonderful vitality, plus his ability, placed him in leadership, and he chose to champion the cause of reclamation not only for the upbuilding of the Northwest but as a national policy.

The late Dr. Elwood Mead, Commissioner of Reclamation, numbered Colonel Robertson among his friends. Two such strong characters could not always agree, but the result of their cooperation was the furtherance of the national reclamation policy.

ADMINISTRATIVE ORGANIZATION OF THE BUREAU OF RECLAMATION

HAROLD L. ICKES, SECRETARY OF THE INTERIOR

EBERT K. BURLEW, FIRST ASSISTANT SECRETARY, in charge of reclamation

John C. Page, Commissioner — **Roy B. Williams**, Assistant Commissioner

J. Kennard Cheadle, Chief Counsel and Assistant to Commissioner; Miss Mae A. Schnurr, Chief, Division of Public Relations; George O. Sanford, General Supervisor of Operation and Maintenance; D. S. Stuver, Asst. Gen. Supr.; Wesley R. Nelson, Chief, Engineering Division; P. I. Taylor, Assistant Chief; A. R. Golzé, Supervising Engineer, C. C. C. Division; William F. Kubach, Chief Accountant; Charles N. McCulloch, Chief Clerk; Jesse W. Myer, Chief, Mails and Files Division; Miss Mary E. Gallagher, Secretary to the Commissioner

Denver, Colo., United States Customhouse

R. F. Walter, Chief Eng.; S. O. Harper, Asst. Chief Eng.; J. L. Savage, Chief Designing Eng.; W. H. Nalder, Asst. Chief Designing Eng.; L. N. McClellan, Chief Electrical Eng.; Kenneth B. Keener, Senior Engineer, Dams; H. R. McBirney, Senior Engineer, Canals; E. B. Debler, Hydraulic Eng.; I. E. Houk, Senior Engineer, Technical Studies; Spencer L. Baird, District Counsel; L. R. Smith, Chief Clerk; Harry Caden, Fiscal Agent; Vern H. Thompson, Purchasing Agent; C. A. Lyman and Henry W. Johnson, Field Representatives; L. S. Davis, Engineer, C. C. C. Division

Projects under construction or operated in whole or in part by the Bureau of Reclamation

Project	Office	Official in charge		Chief clerk	District counsel	
		Name	Title		Name	Address
All-American Canal [1]	Yuma, Ariz.	Leo J. Foster	Constr. engr.	J. C. Thrailkill	R. J. Coffey	Los Angeles, Calif.
Belle Fourche	Newell, S. Dak.	F. C. Youngblutt	Superintendent	J. P. Siebeneicher	W. J. Burke	Billings, Mont.
Boise	Boise, Idaho	R. J. Newell	Constr. engr.	Robert B. Smith	B. E. Stoutemyer	Portland, Oreg.
Boulder Dam and power plant [1]	Boulder City, Nev.	Ralph Lowry	Constr. engr.	Gail H. Baird	R. J. Coffey	Los Angeles, Calif.
Buffalo Rapids	Glendive, Mont.	Paul A. Jones	Constr. engr.	Edwin M. Bean	W. J. Burke	Billings, Mont.
Carlsbad	Carlsbad, N. Mex.	L. E. Foster	Superintendent	E. W. Shepard	H. J. S. Devries	El Paso, Tex.
Central Valley	Sacramento, Calif.	W. R. Young	Constr. engr.	E. R. Mills	R. J. Coffey	Los Angeles, Calif.
Colorado-Big Thompson	Denver, Colo.			Ewalt P. Anderson	J. R. Alexander	Salt Lake City, Utah
Colorado River	Austin, Tex.	Ernest A. Moritz	Constr. engr.	William F. Sha	H. J. S. Devries	El Paso, Tex.
Columbia Basin	Coulee Dam, Wash.	F. A. Banks	Constr. engr.	C. B. Funk	B. E. Stoutemyer	Portland, Oreg.
Fruit Grower's Dam	Delta, Colo.	Clyde H. Spencer	Constr. engr.		J. R. Alexander	Salt Lake City, Utah.
Gila	Yuma, Ariz.	Leo J. Foster	Constr. engr.		R. J. Coffey	Los Angeles, Calif.
Grand Valley	Grand Junction, Colo.	W. J. Chiesman	Superintendent	Emil T. Ficenec	J. R. Alexander	Salt Lake City, Utah.
Humboldt	Lovelock, Nev.	Stanley R. Marean	Resident engr. [2]	George B. Snow	J. R. Alexander	Salt Lake City, Utah.
Kendrick	Casper, Wyo.	H. W. Bashore	Constr. engr.	C. M. Voyen	W. J. Burke	Billings, Mont.
Klamath	Klamath Falls, Oreg.	B. E. Hayden	Superintendent	W. I. Tingley	B. E. Stoutemyer	Portland, Oreg.
Milk River	Malta, Mont.	H. H. Johnson	Superintendent	E. E. Chabot	W. J. Burke	Billings, Mont.
Fresno Dam	Havre, Mont.	H. V. Hubbell	Constr. engr.	E. E. Chabot	W. J. Burke	Billings, Mont.
Minidoka	Burley, Idaho	Dana Templin	Superintendent	G. C. Patterson	B. E. Stoutemyer	Portland, Oreg.
Moon Lake	Duchesne, Utah	E. J. Westerhouse	Constr. engr.	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
North Platte	Guernsey, Wyo.	C. F. Gleason	Supt. of power	A. F. Stimpfig	W. J. Burke	Billings, Mont.
Orland	Orland, Calif.	D. L. Carmody	Superintendent	W. D. Funk	R. J. Coffey	Los Angeles, Calif.
Owyhee	Boise, Idaho	R. J. Newell	Constr. engr.	Robert B. Smith	B. E. Stoutemyer	Portland, Oreg.
Parker Dam	Parker Dam, Calif.	Howard P. Bunger	Constr. engr.	George W. Lyle	R. J. Coffey	Los Angeles, Calif.
Pine River	Durango, Colo.	Charles A. Burns	Constr. engr.	John S. Martin	J. R. Alexander	Salt Lake City, Utah.
Provo River	Salt Lake City, Utah	E. O. Larson	Engineer	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
Rio Grande	El Paso, Tex.	L. R. Fiock	Superintendent	H. H. Berryhill	H. J. S. Devries	El Paso, Tex.
Caballo Dam	Caballo, N. Mex.	S. F. Crecelius	Constr. engr.	H. H. Berryhill	H. J. S. Devries	El Paso, Tex.
Riverton	Riverton, Wyo.	H. D. Comstock	Superintendent	C. B. Wentzel	W. J. Burke	Billings, Mont.
Bull Lake Dam	Riverton, Wyo.	Arthur P. Smyth	Resident engr.	Chas. B. Wentzel	W. J. Burke	Billings, Mont.
Salt River	Phoenix, Ariz.	E. C. Koppen	Constr. engr.	Edgar A. Peck	R. J. Coffey	Los Angeles, Calif.
Sanpete	Salt Lake City, Utah	E. O. Larson	Engineer	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
Shoshone	Powell, Wyo.	L. J. Windle	Superintendent [2]	L. J. Windle [2]	W. J. Burke	Billings, Mont.
Heart Mountain division	Cody, Wyo.	Walter F. Kemp	Constr. engr.	L. J. Windle [2]	W. J. Burke	Billings, Mont.
Sun River, Greenfields division	Fairfield, Mont.	A. W. Walker	Superintendent		W. J. Burke	Billings, Mont.
Truckee River Storage	Reno, Nev.	Charles S. Hale	Constr. engr.	George B. Snow	J. R. Alexander	Salt Lake City, Utah.
Umatilla (McKay Dam)	Pendleton, Oreg.	C. L. Tice	Reservoir supt.		B. E. Stoutemyer	Portland, Oreg.
Uncompahgre: Repairs to canals	Montrose, Colo.				J. R. Alexander	Salt Lake City, Utah.
Upper Snake River Storage [3]	Ashton, Idaho	H. A. Parker	Constr. engr.	Emmanuel V. Hillius	B. E. Stoutemyer	Portland, Oreg.
Vale	Vale, Oreg.	C. C. Ketchum	Superintendent		B. E. Stoutemyer	Portland, Oreg.
Yakima	Yakima, Wash.	J. S. Moore	Superintendent	Philo M. Wheeler	B. E. Stoutemyer	Portland, Oreg.
Roza division	Yakima, Wash.	Charles E. Crownover	Constr. engr.	Alex S. Harker	B. E. Stoutemyer	Portland, Oreg.
Yuma	Yuma, Ariz.	C. B. Elliott	Superintendent	Noble O. Anderson	R. J. Coffey	Los Angeles, Calif.

[1] Boulder Canyon. [2] Acting. [3] Island Park and Grassy Lake Dams.

Projects or divisions of projects of Bureau of Reclamation operated by water users

Project	Organization	Office	Operating official		Secretary	
			Name	Title	Name	Address
Baker (Thief Valley division) [1]	Lower Powder River irrigation district	Baker, Oreg.	A. J. Ritter	President	F. A. Phillips	Keating
Bitter Root [4]	Bitter Root irrigation district	Hamilton, Mont.	N. W. Blindauer	Manager	Elsie H. Wagner	Hamilton.
Boise [1]	Board of Control	Boise, Idaho	Wm. H. Tuller	Project manager	L. P. Jensen	Boise.
Boise	Black Canyon irrigation district	Notus, Idaho	W. H. Jordan	Superintendent	L. M. Watson	Caldwell.
Frenchtown	Frenchtown irrigation district	Frenchtown, Mont.			Ralph P. Schelleer	Huson
Grand Valley, Orchard Mesa [3]	Orchard Mesa irrigation district	Grand Jctn., Colo.	C. W. Tharp	Superintendent	C. J. McCormich	Grand Jctn.
Huntley [4]	Huntley irrigation district	Ballantine, Mont.	E. E. Lewis	Manager	H. S. Elliott	Ballantine.
Hyrum [3]	South Cache W. U. A.	Hyrum, Utah	B. L. Mendenhall	Superintendent	Harry C. Parker	Logan
Klamath, Langell Valley [1]	Langell Valley irrigation district	Bonanza, Oreg.	Chas. A. Revell	Manager	Chas. A. Revell	Bonanza.
Klamath, Horsefly [1]	Horsefly irrigation district	Bonanza, Oreg.	Henry Schmor, Jr.	President	Dorothy Eyers	Bonanza
Lower Yellowstone [4]	Board of Control	Sidney, Mont.	Axel Persson	Manager	Axel Persson	Sidney
Milk River: Chinook division [4]	Alfalfa Valley irrigation district	Chinook, Mont.	A. L. Benton	President	R. H. Clarkson	Chinook
Minidoka: Gravity [1]	Minidoka irrigation district	Rupert, Idaho	Frank A. Ballard	Manager	O. W. Paul	Rupert.
Pumping [1]	Burley irrigation district	Burley, Idaho	Hugh L. Crawford	Manager	Frank O. Redfield	Burley.
Gooding [1]	Amer. Falls Reserv. Dist. No. 2	Gooding, Idaho	S. T. Baer	Manager	Ida M. Johnson	Gooding.
Newlands [3]	Truckee-Carson irrigation district	Fallon, Nev.	W. H. Wallace	Manager	H. W. Emery	Fallon
North Platte: Interstate division [4]	Pathfinder irrigation district	Mitchell, Nebr.	T. W. Parry	Manager	Flora K. Schroeder	Mitchell.
Fort Laramie division [4]	Gering-Fort Laramie irrigation district	Gering, Nebr.	W. O. Fleenor	Superintendent	C. G. Klingman	Gering.
Fort Laramie division [4]	Goshen irrigation district	Torrington, Wyo.	Bert L. Adams	Superintendent	Mary E. Harrach	Torrington
Northport division [4]	Northport irrigation district	Northport, Nebr.	Mark Iddings	Superintendent	Mabel J. Thompson	Bridgeport.
Okanogan [1]	Okanogan irrigation district	Okanogan, Wash.	Nelson D. Thorp	Manager	Nelson D. Thorp	Okanogan.
Salt Lake Basin (Echo Res.)	Weber River Water Users' Assn.	Ogden, Utah	D. D. Harris	Manager	D. D. Harris	Layton.
Salt River [2]	Salt River Valley W. U. A.	Phoenix, Ariz.	H. J. Lawson	Superintendent	F. C. Henshaw	Phoenix.
Shoshone: Garland division [4]	Shoshone irrigation district	Powell, Wyo.	M. P. McLaughlin	Irri. superintendent	Geo. W. Atkins	Powell.
Frannie division [4]	Deaver irrigation district	Deaver, Wyo.	Floyd Lucas	Superintendent	Lee N. Richards	Deaver.
Strawberry Valley [3]	Strawberry Water Users' Assn.	Payson, Utah	S. W. Grotegut	Manager	E. G. Breeze	Payson.
Sun River: Fort Shaw division [4]	Fort Shaw irrigation district	Fort Shaw, Mont.	C. L. Bailey	Manager	E. J. Gregory	Fort Shaw.
Greenfields division [4]	Greenfields irrigation district	Fairfield, Mont.	A. W. Walker	Manager	H. P. Wangen	Fairfield.
Umatilla: East division [1]	Hermiston irrigation district	Hermiston, Oreg.	E. D. Martin	Manager	Enos D. Martin	Hermiston.
West division [1]	West Extension irrigation district	Irrigon, Oreg.	A. C. Houghton	Manager	A. C. Houghton	Irrigon.
Uncompahgre [3]	Uncompahgre Valley W. U. A.	Montrose, Colo.	Jesse R. Tompson	Acting superintendent	J. Frank Anderson	Montrose.
Yakima, Kittitas division [1]	Kittitas reclamation district	Ellensburg, Wash.	V. W. Russell	Manager	G. L. Sterling	Ellensburg.

[1] B. E. Stoutemyer, district counsel, Portland, Oreg.
[2] R. J. Coffey, district counsel, Los Angeles, Calif.
[3] J. R. Alexander, district counsel, Salt Lake City, Utah.
[4] W. J. Burke, district counsel, Billings, Mont.

Important investigations in progress

Project	Office	In charge of—	Title
Colorado River Basin, sec. 15	Denver, Colo.	P. J. Preston	Senior engineer.
Boise-Weiser-Payette	Boise, Idaho	Lester C. Walker	Engineer.
Cabinet Gorge	Clarks Fork, Idaho	Wm. G. Sloan	Engineer.
Kings River-Pine Flat	Fresno, Calif.	John R. Iakisch	Constr. engineer.
Western Slope (Colo.)	Denver, Colo.	Frank C. Merriell	Engineer.
Black Hills	Denver, Colo.	R. E. Kennedy	Assistant engineer.
Eastern Slope (Colo.)	Denver, Colo.	A. N. Thompson	Engineer.
Salt Lake Basin	Salt Lake City, Utah	E. O. Larson	Engineer.
Grande Ronde	La Grande, Oreg.	C. C. Fisher	Engineer.
Marias	Shelby, Mont.	Fred H. Nichols	Associate engineer
Green River-Bear River	Denver, Colo.		

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THIRTY ACRES OF IDAHO SPUDS UNDER IRRIGATION

THE RECLAMATION ERA

MAY 1938

ABUNDANT MOUNTAIN SNOWS FORECAST FULL RESERVOIRS ON RECLAMATION PROJECTS

MOFFAT TUNNEL HEARING

ON MAY 6, a hearing was held in the Office of the Secretary of the Interior on a petition filed with him by the Moffat Tunnel Water & Development Co. to restore to the public domain lands withdrawn by the Department in connection with the Colorado-Big Thompson project, which the company desires for rights-of-way in connection with its plan to carry water through the Moffat Tunnel to lands on the east slope of the Continental Divide.

Representatives of the State of Colorado, the State's National Representatives in Congress, and others interested were in attendance.

COLORADO WATER CONSERVANCY ACT CONSTITUTIONAL

ON MONDAY, MAY 2, the supreme court of the State of Colorado handed down a decision holding the water conservancy act of Colorado to be constitutional. The cost of the irrigation feature of the Colorado-Big Thompson project is to be repaid by the Northern Colorado Water Conservancy District organized under this act. The decision clears the way for the execution of a repayment contract with the district.

JOHN C. PAGE, *Commissioner.*

PRICE
ONE
DOLLAR
A YEAR

THE RECLAMATION ERA

VOLUME 28 • MAY 1938 • NUMBER 5

THE ENGINEER PLUS

By JOHN C. PAGE, *Commissioner of Reclamation* [1]

WE ARE in a new day which opens many broad opportunities to the engineer, but before he can seize them he must be an engineer plus.

He must be an engineer as adept as ever with his slide rule, his transit, and his blueprints, but he needs additional qualifications of leadership and broad social knowledge to assume the place which may be his in this new era which will emphasize conservation. It is as important to the Nation as to the engineering profession that we develop these engineers with something more than technical knowledge and skill. It is important because all branches of the conservation movement need trained engineers, with vision, to assist in or to take the lead in carrying out the rebuilding programs which must be launched.

Conservation is not a political issue; it draws its supporters from all parties and all walks of life. Introduction of a comprehensive conservation program at this time means that we are turning our backs upon the practice of exploiting our national resources for temporary and immediate gain without regard for the future. It means that we have substituted, rather, a policy of husbanding our resources in a manner which will result in their broad and most beneficial use in our generation, and yet will preserve their usefulness for future generations.

There are two reasons why this more enlightened policy has come so forcefully to the front in the past few years. One is that our national leaders, headed by President Franklin Delano Roosevelt and Secretary of the Interior Harold L. Ickes, are devoted conservationists. The other is that exploitation and misuse of our resources has reached the point where nature herself is taking a hand in the education of the Nation.

Without leadership, nothing permanent can be accomplished. That is why it is so important that the engineering profession develop understanding leaders. Without a broad and general understanding of the problems involved, the mass support which is necessary to any fundamental change in policy cannot be generated. That is where the floods, the droughts, and the dust storms have played so great a part.

Although these lessons, administered by Mother Nature to us, her children, have been painful and costly in the extreme, they have served to bring home to almost every individual in the United States the fact that he has a personal interest in the success of a well-rounded and intelligently applied conservation program.

Soil and Water Conservation

Soil and water are our two primary resources. It took the terrible droughts in the Great Plains of 1934 and 1936 and the unprecedented floods in the Ohio and New England valleys and in California to make everyone aware of the fact that our soil and our water needed protection, else their usefulness at least might be destroyed. All other forms of conservation are related to these two and, moreover, the conservation of soil and the conservation of water are inseparably joined together. It would be shortsighted, therefore, to sponsor a program which embraced but a single link in the whole interconnected chain.

It has been a comparatively short time since the conservationists were divided into small camps, each battling under its own standard for preservation and protection of wild water fowl, of our native big game species, of the fish in the stream, of our forests and woodlands and of wilderness areas, thus dissipating against a wall of inertia the strength of forces which, combined, might have brought much earlier the profound changes in national attitudes which are now in progress.

It has been only recently that these various elements have been pooled together by leaders of broader vision.

Work of National Resources Committee

One of the most significant developments of recent years in this field has been the leadership and the work of the National Resources Committee, which has made studies and important contributions to the advancement of the conservation cause. Its Water Resources Committee has done a pioneering work of great value in assembling information concerning the water problems of every locality in the United States and in the formulation of a planned program for their solution.

In its review of the Missouri River and its tributaries, the Water Resources Committee made some pertinent observations with respect to the situation in middle and western Nebraska and other areas of the Great Plains. The water supply of this region, it said, could be improved materially (1) by construction of small dams to provide stock water in grazing areas; (2) springs may be improved, shallow wells dug, and deep wells drilled for stock water; (3) in some stock-raising areas unappropriated water may be stored and used for irrigation of forage crops, thus building up feed reserves. This type of improvement is limited, however, because only a very small amount of the scanty rainfall normally reaches the river system; and (4) in some areas devoted mainly to dry farming, opportunities exist here and there for irrigating tracts from reservoirs or wells.

With respect to large irrigation projects in this area, the committee pointed out: "Large irrigation projects are not feasible in most parts of the Great Plains, partly because they do not yield substantial benefits in wet years and so fall into disuse, and partly because of the high cost of water in relation to the benefits obtained from its use." The committee named a long list of projects which should receive consideration in this area and which would fit into an intelligent and integrated program for water- and land-use stabilization.

The Water Resources Committee has recognized that water-use and land-use problems are related and that plans for a permanent solution of the one must be coordinated with plans for the solution of the other.

The flood does not originate in the stream, but it has its birth when the raindrop reaches the ground. Deforested hillsides, overgrazed highlands, the cultivation of steep slopes—all problems in land use—contribute to the violence of the flood. It might be said, as well, that a drought is not solely a land-use prob-

[1] Address delivered at the annual round-up of the Nebraska Engineering Society at Omaha, Nebr., April 2, 1938.

lem, for the draining of subsoils by an overdraft on underground water supplies and the fluctuation of controllable streams may contribute at least to the severity of the consequences of a drought.

Functions of Engineering Profession

Whether the problem is reforestation of mountain slopes, control of erosion in the fertile plateaus, abatement of pollution in the eastern rivers, rehabilitation of the habitat of wildlife, irrigation, flood control or any of the others, which must be solved in the conservation of our resources, it involves engineering problems. Work for the engineer is one of the threads which binds all of these together. It obviously is important, therefore, for the engineer to understand these problems and to take the leadership in developing a plan for their solution. It no longer is sufficient for an engineer to know how to build a dam; if he is to fulfill his highest duty, he must know also why the structure is to be built and he should be in a position, as well, to say whether the dam will serve its purpose.

Not long ago a prominent engineer told me that he once worked on the problem of designing a water retention system in the Sierra Nevadas of California for 5 years before he discovered who expected to build the system and for what purpose the water was wanted. He was merely applying his training and skill to an abstract problem. Under those circumstances his contributions could have been no more than a perfection of the engineering drawings for a dam.

The engineering profession must make its influences felt further than the drafting room, but it cannot unless it applies its thought to social and economic problems and lends its influence and leadership to their correction.

The Bureau of Reclamation, with which I am connected, has in its charge the execution of one of the great social programs of the country. This organization is peopled largely by engineers. Throughout its long history, the fundamental purposes of the Bureau of Reclamation have been to provide homes for people and to develop the West through the conservation of the meager water resources of this arid and semiarid region.

Much of our work is engineering work, as is indicated by the facts that we have constructed 138 dams and now we are building a score more, and that we have built about 20,000 miles of canals and are building many more long canals at the present time. Certainly the engineer plays a major part in this phase of the conservation program.

Grand Coulee Dam, Columbia Basin Project, under construction by the Bureau of Reclamation, will conserve the water of the Columbia River and make possible about 40,000 successful farm homes in the vast dry basin which it will irrigate.

Value of Reclamation

Despite the engineer's function here, the value of the Reclamation program is and must be judged by the social and economic results of the construction and not by the construction itself. The significance of the Federal Reclamation program lies in these facts: We have made homes for almost 900,000 persons on 48,773 farms and in 257 towns and cities by the irrigation of about 3,000,000 acres of land in projects scattered throughout the arid West. Using water which otherwise would be wasted, perhaps in destructive floods, upon lands which otherwise must have remained useless desert, these human opportunities have been created. Since this work began in 1902, crops valued at nearly 2½ billions of dollars, or more than 10 times the cost of the irrigation works of the projects which now are being operated, have been harvested and marketed by the farmers in these irrigated areas. This means the addition of a tremendous amount of wealth to the country as a whole.

Incidental to the work of irrigating farms the Bureau of Reclamation has provided on 12 projects, power plants which furnish cheap energy to light the rural homes, to run the farm machinery, as well as to operate the pumps and gates of the irrigation system itself. The revenues from this byproduct of irrigation assist the water user in repaying the cost of his construction. This is another important social contribution.

The State and local governments, the schools, churches, and other community institutions of wide areas in the West owe their

major support to the fact that irrigation projects have been built. In addition, the existence of transcontinental railroads, transcontinental telegraph and telephone systems, and of transcontinental highways is largely dependent upon the fact that the great intermountain desert can be bridged on the buttresses formed by irrigation projects.

The livestock industry in the West, its largest, obtains approximately one-half of the feed which supports it from the public ranges and the other half from the irrigated areas, which are mere dots in the landscape.

With so much depending upon the success of the program, its administration is a grave responsibility. The water supply of the western one-third of our country is severely limited. The land resources of that area are so great by comparison that literally hundreds of millions of acres can never be used. Of 700,000,000 acres in the arid and semiarid West, 20,000,000 acres now are developed by irrigation. It is estimated that the remaining unused water resources will irrigate only an additional 10,000,000 acres with projects which can be considered feasible at the present time. Projects now under construction by the Bureau of Reclamation will bring in, on their completion, about one quarter of the remaining feasibly irrigable lands. The selection of the lands which are to be developed in the future is a serious matter.

From the beginning of Federal Reclamation, administration and execution of this policy has been in the hands of men recruited from the engineering profession. Its achievements to date and the success or failure of the program in the future, to a great extent, will be the responsibility of the Nation's engineers. I cite this example because it is one with which I am familiar and because it serves to emphasize the earlier statement that the engineer must prepare himself as a professional man to take an important part or assume leadership in the conservation of our resources.

Only recently I attended a session of the National Wild Life Institute. There I heard one of the leaders in the work of that organization state that one of the most pressing present needs in his field was for skilled engineers who were familiar with the objectives of the organization and upon whom this group of conservationists could rely for leadership.

This holds true throughout the scale of conservation. Let me repeat, that conservation at this stage involves much reconstruction and a great deal of building for protection of resources.

Curtailment of soil erosion involves the construction of protective works, of check dams, and other structures. Flood control, in many instances, can best be accomplished by the building of big dams and channel improvements—engineering work. Protection of the public ranges from overgrazing, one of the newest conservation activities launched, requires the improvement of stock watering facilities, another job for the engineer. Abatement of pollution: more work for the engineer in design and construction of disposal plants, in regulating the flow of streams. The list could be extended.

Right here in Nebraska, you have a major water conservation problem. This State extends from the arid to the humid sections. Its central portion is arid and humid by turns, depending upon the weather. For any permanent solution of Nebraska's problem, this fact must be recognized, and proper steps taken to prevent overexpansion during wet cycles and subsequent dislodgment of thousands of families during the dry years which follow. The tragedy enacted in the Great Plains during the extended drought which began about 1930 must not be repeated. It need not be.

To prevent a repetition of the situation which has reduced about 100,000 American farm families almost to the status of gypsies, however, will require the concerted efforts of the Federal, State, and local governments, and, I believe, the leadership of the engineers.

Wise water use and sound land use alone will prevent another cycle of overdevelopment accompanying another cycle of wet years; and another tragic exodus forced by a future drought. It is not enough to work out the theoretical best means for the future use of the Great Plains, for unless the engineers determine where and in what quantities ground and surface waters may be used, it will go for naught. Neither is it enough for the engineers to measure wells and the flow of streams, to build dams and canals, for unless these are fit precisely into a general plan which considers also the social and economic problems involved, they will not result in insurance against future tragedies like that of the present, which has made so many homeless.

The times cry loudly for the engineer with a social conscience, both in the service of the Government and in private practice. Responsibility for many of the programs and much of the rebuilding for conservation of necessity must be accepted by the Federal and local governments. A large proportion of the American engineers is called upon at some time to serve the State. Because of this, if for no other reason, engineers generally ought to know something about the public weal.

The comment of Secretary Ickes, my chief, on the engineer is to the point. He said, in an address before the Association of American Colleges in Chicago recently:

"Early in my experience in Washington, I discovered to my surprise that many engineers considered that they were fully equipped for the public service merely because they were technically trained and had had good engineering experience. On the other hand, I was gratified to discover outstanding engineers like the late Dr. Elwood Mead, Commissioner of Reclamation, and Col. Henry M. Waite, who served the Government as Deputy Administrator of Public Works, who had both keen and well-grounded social consciences. And there are many others like them.

"My theory has been that an engineer who offers himself for service to his Government ought to have democratic ideals, and I am not using "democratic" in a partisan sense. I believe he ought to know something about the social and economic problems that we are facing and which we must solve wisely if we are to make our democracy work. I insist that an engineer can be just as good an engineer, and perhaps even a better one, if, at the same time, he had a broad social outlook. An engineer not only ought to be competent as to engineering technique, he also ought to know for what purpose and in whose interest he is employing his technique."

This challenge by the Secretary to the schools to produce the engineer plus should not be disregarded by the practicing members of the profession.

Perhaps what I have been saying here boils down into a plea for a more professional approach to engineering; for the elevation of this work from simple craftsmanship, no matter how highly skilled, to a higher plain of professional attainment. I would like to see this end achieved, because I am an engineer and because I am employed by the Government in a conservation activity.

In any event, the opportunity is present for the engineer plus to do a great service to his State and his country. The opportunity is at his elbow, because every locality in the United States has one and most have many more problems crying for solution along sound technical and social lines.

Irrigation in Foreign Countries
Victoria, Australia

FROM the 32d Annual Report of the State Rivers and Water Supply Commission for the fiscal year 1936–37, the following figures regarding irrigation are obtained:

The area irrigation for the past 5 years has been as follows:

Year	*Acres*
1932–33	474, 716
1933–34	435, 324
1934–35	494, 226
1935–36	495, 835
1936–37	518, 827

The entire area of land artificially supplied with water for domestic and stock watering purposes exceeded 15,000,000 acres. There were more than 14,000 miles of canals and drains which were able to serve an irrigable area of approximately 2,000,000 acres of which 518,827 acres were irrigated. The capacity of the storage reservoirs was 1,891,350 acre-feet, including 625,000 acre-feet as the Victoria share of the Hume Reservoir, which has a total capacity of 1,250,000 acre-feet and was filled during the year. A record figure of 2,330,000 cases of canned fruits was produced.

Central Valley Project, California

By WALKER R. YOUNG, *Construction Engineer* [1]

IT IS a trite expression to say that water is the most precious natural resource of California. The pertinent subject for consideration is: What is California doing to conserve and utilize this resource?

California's water problem has been a subject of study by State and Federal agencies for more than half a century. The difficulties arise principally from two conditions of nature, one geographic and the other seasonal. In the Great Central Valley, which is the heart of California, the water resources are out of balance with the irrigable lands. Two-thirds of the water which nature supplies, in the form of rain and snow, falls on the watersheds of the Sacramento Valley which has crop lands with about one-third of the relative irrigation need; while one-third of the water falls to the San Joaquin Valley, which has crop lands with two-thirds of the irrigation need. That is the geographical problem.

Then there is seasonal waste. In spite of what has been done so far to conserve stream flows, two-thirds of the water which nature deposits annually on these watersheds flows unused to the sea within 90 days after it has fallen. Almost all the rain and snow come in a few months of winter and early spring, and virtually none in the long hot summer and dry autumn, when water is needed for irrigation. This condition of climate, while essential to our culture of specialized crops in the valley, makes impossible reasonable use of the water resources without rigorous conservation and economic regulation.

Aerial mosaic of dam site with dam and Southern Pacific Railroad bypass tunnel location indicated.

Nature's unregulated water supply in the Great Central Valley is ample. The recent floods testify to that fact with a vengeance. But the agricultural development of the valley, representing an investment of 2 billion dollars, has far transcended nature's plan of water distribution. This rich development cannot survive on periodic flood and drought. Under existing conditions more than a million acres face an acute irrigation crisis, threatening retirement in some areas of now highly productive lands. The low summer flow of the rivers has put an end to upstream commercial navigation, and has permitted encroachment of salt water from the ocean upon reclaimed crop lands.

These are symptoms of the conservation problem which the State of California has asked the Federal Government to help solve. That is why the United States Bureau of Reclamation now is engaged in this vast construction program which involves conserving much of the seasonal loss of water by the erection of large storage dams on the Sacramento and San Joaquin Rivers; and relieving the geographical predicament by a redistribution of the conserved water in a system of canals.

Shasta Dam Second in Height to Boulder

The key to the Central Valley's water problem is, of course, the Sacramento River which has a mean annual flow greater than that of the Colorado River. The major unit of the Central Valley project is to be Shasta Dam on the upper Sacramento River north of Redding. It will rise 560 feet from the lowest foundation to the top—second in height only to famed Boulder Dam, the world's highest at 727 feet. Shasta Dam will be about 3,400 feet long on the crest, more than twice as long as Boulder.

It has been designed as a gravity-section concrete dam with a slightly curved axis. It will have a 375-foot overflow spillway in the center. Fifteen water outlets will be pro-

[1] Address delivered before Annual Meeting of the Rock, Sand, and Gravel Producers Association of Northern California, March 17, 1938, in San Francisco.

vided through the dam for river regulation. Five penstocks will lead to a 350,000-kilowatt hydroelectric plant to be located below the dam on the west bank of the river.

Necessary accessory jobs at Shasta include reconstruction around the reservoir site of part of the Southern Pacific's main line between here and Portland, Oreg., and part of the Golden State Highway leading over the Siskiyous. The new railroad, 30 miles long, will include 12 tunnels and 8 bridges. In order to permit an early start of work on Shasta Dam, without waiting for completion of this new railroad above the water line, a temporary tunnel is to be built under the west abutment at the dam site in the Sacramento Canyon, for diversion of the existing railroad during the first period of dam construction. Advertisements have been issued for construction of the railroad diversion tunnel which later is to be utilized as a water conduit.

Shasta Reservoir will have a gross storage capacity of 4½ million acre-feet—water enough to cover the entire city of San Francisco to a depth of 167 feet. This reservoir will be operated to diminish the flow of the Sacramento River during flood times and to increase it during the dry months, in other words, stabilize the year-round flow, to check seasonal waste of water, permit a restoration of all-year navigation far above the city of Sacramento, afford improved irrigation in much of the Sacramento Valley, and repel seasonal encroachment of salt water into the channels of the Sacramento-San Joaquin delta. Incidentally, the release of water at Shasta Dam will generate about 1½ billion kilowatt-hours of electricity annually for municipal, industrial, agricultural, and project use. Finally, when the conserved waters of the Sacramento River have performed all of these functions, and have passed every possible user on that river, they will afford a surplus for delivery by canal to Contra Costa County and the San Joaquin Valley.

That brings us to the delta features of the Central Valley project. A cross channel will be constructed, generally by widening and improving existing waterways, to facilitate the fresh-water flushing of the sometimes-salty delta channels and sloughs and the introduction of surplus Sacramento River water into the lower San Joaquin at the intakes of the Contra Costa Canal and the San Joaquin Pumping System. The Contra Costa Canal, which as you probably know already is under construction, will extend 48 miles from the San Joaquin River at Rock Slough to a small reservoir above Martinez. It will afford a dependable supply of fresh water for industrial use in manufacturing and processing plants along the south shore of Suisun Bay, for domestic use in several Contra Costa municipalities, and for agricultural use in an upland area of orchard and field crops.

The San Joaquin pumping system will comprise a series of works to lift water in artificial and natural channels up the northern San Joaquin Valley about 135 miles to Mendota to

Shasta Dam site. Aerial oblique photograph of dam site looking upstream.

furnish substitute water from the delta to lands in the northerly half of the San Joaquin Valley now irrigated by San Joaquin River water that is to be conserved and diverted at Friant Dam.

Friant Dam

Friant Dam, on the upper San Joaquin River near Fresno, will be a sizeable structure in itself. Although only about half as high as Shasta—286 feet compared to Shasta's 560—it virtually will be as long—3,300 feet, against Shasta's 3,400, or about two-thirds of a mile from end to end on the crest. Friant Dam will be a straight gravity structure with an overflow spillway in the river section. There will be outlet conduits through the dam for river regulation and similar outlets to the Friant-Kern and Madera canals, which originate at the dam.

To many people in the rich agricultural counties of the southern San Joaquin Valley, whose very existence depends upon an adequate supply of water for irrigation, the most important features of the Central Valley project will be the two large gravity canals leading from Friant, one southerly a total length of 157 miles to the Kern River west of Bakersfield and the other northerly 40 miles to the Chowchilla River above Madera.

The Friant-Kern Canal, in popular conception, will be a "young river"—68 feet wide at the water surface and 15 feet deep in its upper reaches. This concrete-lined channel, 30 feet wide at the bottom, will have a capacity of 3,500 second-feet for the first 30 miles, decreasing in size thereafter in accordance with the amounts of water to be taken out at various delivery points. The Madera Canal, with a diversion capacity of 1,000 second-feet, will be 10 feet wide at the bottom, 32 feet wide at the water surface, and will carry water 9 feet deep. These two canals will deliver supplements water to parts of Fresno, Madera, Tulare, Kings, and Kern counties, where failure of existing water supplies already has caused the abandonment of more than 40,000 acres of once-lush crop lands.

Construction of the Central Valley project, involving besides the dams and canals many auxiliary structures such as bridges, tunnels, inverted siphons, culverts, and wasteways, will be of tremendous significance to California. It will require an infinite variety of heavy machinery and equipment; it will absorb raw materials and manufactured products from virtually every county in the State, and from many other States; and it will provide employment to several thousand persons over a period of several years.

Shasta Dam's estimated concrete requirement is 5,700,000 cubic yards, about 1⅔ times the amount which went into Boulder Dam and appurtenant works. In terms of materials for concrete, this is a requirement for about 11 million tons of pit-run aggregate. Possible sources of supply exist in gravel deposits lo-

cated along the Sacramento River from which the material might be transported to the dam site over the existing canyon railroad or by tramway. Besides this water-borne material, rock deposits of several types suitable for quarrying and crushing occur in the general vicinity of Shasta Dam site.

Friant Dam will require about $1\frac{1}{2}$ million cubic yards of concrete, meaning about 3 million tons of aggregate. An adequate supply of suitable material has been found to be available in the immediate vicinity of the dam site.

This deposit also probably will provide part of the aggregate for concrete lining of the Friant-Kern and Madera Canals. The canal lining, $3\frac{1}{2}$ inches thick, will require about 4,600 cubic yards of concrete per mile for the upper sections of the Friant-Kern, and 2,400 cubic yards of concrete per mile for the upper sections of the Madera Canal. It is expected that commercial deposits in other parts of the valley will furnish aggregate for portions of the canals farther removed from Friant. The Bureau of Reclamation recently received bids for furnishing 39,000 tons of gravel and 27,000 tons of sand for the next 17 miles of the Contra Costa Canal for which the 3-inch lining will require about 1,500 cubic yards of concrete per mile. If the adopted plan for the San Joaquin pumping system includes a concrete-lined canal it will be comparable in size to the Friant-Kern Canal.

Cost of Project

The cost of the Central Valley project has been estimated at 170 million dollars. The project is to be self-liquidating under the reclamation laws, with revenues to be derived through sale of the project's two facilities—water and power. The project has been fully authorized by Congress. Funds made available to date have totaled $23,900,000, now partly expended. An additional appropriation of $9,000,000 is pending in the current Interior Department appropriation bill passed by the House and now before the Senate.

Benefits to Follow Construction

Popular interest in the project to date, particularly outside the semiarid Great Central Valley, has been concentrated generally upon the imminent construction era and the immediate benefits to be derived from large-scale employment and heavy expenditures for materials, equipment, and supplies. Of greater significance, however, are the more lasting benefits of improved navigation and flood control; adequate water supplies for irrigation, salinity repulsion, industrial and municipal use; and the substantial electric power development, all of which will follow completion of this great conservation program. These are factors upon which California will realize regular dividends long after the last yard of concrete has been poured.

Forecasting detailed consequences of any public improvement several years in advance is hazardous. But, given an adequate water supply, the Great Central Valley appears to have a manifest destiny of agricultural wealth and importance that can not be denied. Unlike gold mines and oil wells, which are exhaustible, irrigation production continues year after year, indefinitely. We can point with positiveness to arid areas, most of them less favorably endowed than California's Central Valley, where reclamation has yielded high returns in increased population, expanding agricultural output, attendant industrial development, substantial transportation revenues, and business improvement.

For instance, comparable to the Great Central Valley, except in size, is the Yakima Valley in the State of Washington where a comprehensive analysis has been made by research economists of reclamation's contribution to national wealth. There the Bureau of Reclamation, starting in 1906, has built the Yakima project. Intensive farming has been made possible on 350,000 acres in the Yakima Valley by reservoirs and canal works constructed at a total cost of $25,700,000. A report of the Washington State Planning Council says:

"New wealth produced in the Yakima Valley totals 50 million dollars annually, approximately twice the over-all cost of the irrigation works. More than half this wealth is expended for the products of eastern industries. Over 10 million dollars annually is paid to the railroads as freight on crops grown in the Yakima Valley."

The report reveals that the population of four irrigation counties of the Yakima Valley increased under 30 years of Federal Reclamation from 30,000 to 120,000; while the population of four adjacent dry-farming counties increased during the same period from 25,000 to only 38,000.

Another spectacular illustration of what water can do for a territory is offered by the San Fernando Valley in southern California. There an acute need for water delayed development of a potentially prosperous area until the Los Angeles aqueduct project gave assurance of a dependable water supply. Thereafter, according to Los Angeles County records, assessed valuations of property increased in a few years an average of 1,500 percent.

A short time ago President Roosevelt transmitted to Congress a report of the National Resources Committee for a long-range plan for conservation and development of this country's water resources. In it the committee reiterated a previous observation on California's water problem as follows:

"In the future, as well as now, the extent of California's agriculture will be limited by the supply of water for irrigation. In the future, even more than now, its industries will depend for power on hydroelectric energy. The future of its cities, no less than that of its farm lands and factories, will be influenced greatly by the supply of water available to them. * * * Completion of the Central Valley project as soon as practicable is of prime importance."

Rio Grande Compact Commission Reports

ON MARCH 18, 1938, the Rio Grande Compact Commission, in session at Santa Fe, N. Mex., signed a permanent compact for an equitable division of the waters of the Rio Grande. The three States involved are Colorado, New Mexico, and Texas. Mr. S. O. Harper, assistant chief engineer of the Bureau of Reclamation, served as representative of the United States and chairman of the Commission. The other members were Mr. M. C. Hinderlider for Colorado, Mr. Thomas M. McClure for New Mexico, and Mr. Frank B. Clayton for Texas. The Commission was organized on December 10, 1934. Six meetings were held at Santa Fe, the final meeting lasting from March 3 to 18, 1938. The compact to be effective must be ratified by the legislatures of the three States involved. If ratified it will end over 40 years of controversy and dispute on this water problem among these States. It is the unanimous opinion of the Commissioners and their advisers that the compact provides an eminently fair and equitable solution of the problem involved and that the interests of the United States are fully safeguarded.

The original compact will be deposited in the archives of the Department of State and duly certified copies forwarded to the Governors of each of the signatory States for action by their legislatures.

Don Johnstone Becomes Editor of Civil Engineering

WITH the April 1938 issue of Civil Engineering the editorship of the magazine was taken over by Don Johnstone, Jun. Am. Soc. C. E., who was previously, for 3 years, an assistant editor of the society with miscellaneous responsibilities. His work is now being expanded to include not only those departments he had previously handled, but the general editing of the publication.

Following his graduation from the University of Illinois in 1931, Mr. Johnstone was employed at the United States Waterways Experiment Station at Vicksburg, at the Bureau of Reclamation in Denver, and at the United States Engineer Office in Kansas City, from which he came to the society in 1935. He was editor-in-chief of his college engineering magazine, the Technograph, which experience has been supplemented with editorial duties at Vicksburg and at society headquarters. As an undergraduate he was also elected to Chi Epsilon, honorary civil engineering society, and to Tau Beta Pi.—*Civil Engineering.*

NOTES FOR CONTRACTORS

Specification No.	Project	Bids opened	Work or material	Low bidder: Name	Low bidder: Address	Bid	Terms	Contract awarded
758	Central Valley, Calif.	*1938* Feb. 21	Pumping units for pumping plants Nos. 1, 2, 3, and 4, Contra Costa Canal.	Pomona Pump Co.	Pomona, Calif.	$79,302.00	F. o. b. Pomona, f. o. b. E. Pittsburgh (motors)	*1938* Mar. 28
772	Shoshone-Heart Mountain, Wyo.	Mar. 2	Earthwork, canal lining and tunnel, Heart Mountain Canal, stations 15+90 to 27.	J. A. Terteling & Sons	Boise, Idaho	68,538.00		Do.
774	Columbia Basin, Wash., Kendrick, Wyo.	Mar. 31	Eighty-three 102-inch ring-seal gates and 40 conduit linings for Grand Coulee and Seminoe Dams.	Consolidated Steel Corporation, Ltd.	Los Angeles, Calif.	[1] 1,089,937.00	F. o. b. Los Angeles	Apr. 25
				Joshua Hendy Iron Works	San Francisco, Calif.	[2] 854,163.00	F. o. b. Sunnyvale, Calif.	Do.
				United States Pipe & Foundry Co.	Burlington, N. J.	[3] 178,089.00	F. o. b. Bessemer, Ala.	Do.
777	Columbia Basin, Wash.	Mar. 16	Trashrack metalwork for Grand Coulee Dam.	Bethlehem Steel Co.	Bethlehem, Pa.	[4] 323,026.00	F. o. b. Chicago	Apr. 4
				John W. Beam	Denver, Colo.	[5] 19,750.00	F. o. b. Peotone, Ill. Discount ½ percent	Do.
				Mississippi Valley Structural Steel Co.	Melrose Park, Ill.	[6] 58,300.00	F. o. b. Odair, Wash.	Do.
				Sheffield Steel Corporation	Kansas City, Mo.	[7] 5,566.00	F. o. b. Kansas City. Discount 1 percent.	Apr. 1
778	Sun River, Mont.	Mar. 1	Enlargement of Sun River Slope Canal, stations 535+00 to 1153+24.	Williams and Douglass	Kalispell, Mont.	67,150.00		Mar. 11
780	Central Valley, Calif.	June 1	Construction of Shasta Dam and power plant.					
1024-D	do	Feb. 10	Furnishing and delivering 66,000 tons of sand and gravel for Contra Costa Canal.	Henry J. Kaiser Co.	Oakland, Calif.	[8] 35,800.00	F. o. b. Radum, Calif.	Apr. 8
1029-D	Yuma, Ariz.-Calif.; Rio Grande, N. Mex.-Tex.	do	Radial gate hoists for Siphon Drop power plant and Leasburg Canal.	D. J. Murray Mfg. Co.	Wausau, Wis.	2,502.00	F. o. b. Wausau	Feb. 17
1031-D	Boulder Canyon, Ariz.-Nev.	Feb. 16	Steel structures for transformer circuits and switching stations.	American Bridge Co.	Denver, Colo.	5,684.00	F. o. b. Pittsburgh, Pa.	Feb. 21
1033-D	Belle Fourche, S. Dak.	Feb. 21	One ditch-cleaning and excavating machine.	No bids received				
1035-D	Uncompahgre, Colo.	Feb. 23	One Diesel-engine-powered, convertible-type, dragline excavator.	Bay City Shovels, Inc.	Bay City, Mich.	12,500.00	F. o. b. Bay City. Discount 2 percent.	Mar. 12
1037-D	Central Valley, Calif.	Mar. 1	Materials for steel warehouse building at Shasta Dam.	Worden-Allen Co.	Milwaukee, Wis.	26,751.00	F. o. b. Coram, Calif.	Mar. 28
1038-D	Provo River, Utah	do	Furnishing and delivering 30,000 tons of sand and gravel.	Salt Lake Sand & Gravel Co.	Salt Lake City, Utah	[9] 17,101.00	F. o. b. Nash, Calif. Discount 5 cents per ton.	
1039-D	Klamath, Oreg.-Calif.	Mar. 3	Construction of 4-room residence for the Tule Lake division.	M. W. Cherry	Klamath Falls, Oreg.	3,360.00		Mar. 7
1045-D	Provo River, Utah	Mar. 17	Structural steel for Provo River Bridge.	Bethlehem Steel Co.	Chicago, Ill.	7,521.00	F. o. b. Chicago	Mar. 30
1048-D	All-American Canal, Ariz.-Calif.	Mar. 23	Slide gates, gate hoists, and cast-iron stem guides.	Western Foundry Co.	Portland, Oreg.	4,997.50	F. o. b. Portland	Do.
24608-A-3	Gila, Ariz.	Mar. 11	New steel sheet piling (638 tons)	Carnegie-Illinois Steel Corporation.	Denver, Colo.	45,465.47	F. o. b. Blaisdell, Ariz. Discount ½ percent.	Mar. 28
A-22262-A	Shoshone-Heart Mountain, Wyo.	Mar. 30	Steel reinforcement bars (517,120 pounds).	Colorado Fuel & Iron Co.	do	16,398.34	F. o. b. Mills, Wyo. Discount ½ percent b. p. v.	Apr. 23
1047-D	Columbia Basin, Wash.	Mar. 28	Fabricated pipe, fittings, valves, and appurtenances for Grand Coulee Dam.	Koppers Co. (Western Gas division).	Fort Wayne, Ind.	[10] 39,092.00	F. o. b. Fort Wayne	Apr. 26
				Geo. B. Limbert Co.	Chicago, Ill.	[11] 41,058.00	F. o. b. Chicago	Do.
				R. Hardesty Manufacturing Co.	Denver, Colo.	[5] 33,011.00	F. o. b. Middletown, Ohio. Discount ½ percent.	Do.
				California Steel Products Co.	San Francisco, Calif.	[6] 299.00	F. o. b. San Francisco	Do.
				Midwest Piping & Supply Co.	St. Louis, Mo.[13]	[7] 18,298.00	F. o. b. Odair, Wash.	Do.
				Geo. B. Limbert Co.	Chicago, Ill.	[12] 81,085.00	F. o. b. Chicago	Do.
1044-D	Boulder Canyon, Ariz.-Nev.	Mar. 18	Twelve 15½-inch butterfly valves	Valley Iron Works	Yakima, Wash.	18,631.00	F. o. b. Yakima. Discount 5 percent.	Apr. 23
1040-D	Yuma, Ariz.-Calif.	Mar. 4	Air-cooling, heating and ventilating equipment for office building.	B. K. Stoneman	Los Angeles, Calif.	3,623.00	F. o. b. Yuma	Apr. 11
1051-D	Boulder Canyon, Ariz.-Nev.	Apr. 1	Structural steel for transmission towers for Southern California Edison Co. circuit.	Bethlehem Steel Co.	San Francisco, Calif.	[4] 17,660.00	F. o. b. Boulder City	Apr. 23

[1] Items 1, 3, and 7.
[2] Items 2 and 4.
[3] Items 5 and 6.
[4] Items 1 and 2.
[5] Item 3.
[6] Item 4.
[7] Item 5.
[8] Schedules 2, 5, and 8.
[9] Schedules 1 and 2.
[10] Item 1
[11] Item 2.
[12] Item 6.
[13] Shipping point, Kewanee, Ill.

(Cut along this line)

COMMISSIONER, (Date) ....

Bureau of Reclamation,

Washington, D. C.

SIR: I am enclosing my check [1] (or money order) for $1.00 to pay for a year's subscription to THE RECLAMATION ERA.

Very truly yours,

May 1938 (Name) ....

(Address) ....

[1] Do not send stamps.

NOTE.—36 cents postal charges should be added for foreign subscriptions.

Construction of TAYLOR PARK DAM
Uncompahgre Project, Colorado

By DONALD JERMAN, *Engineer, Bureau of Reclamation*

TAYLOR PARK DAM, completed November 29, 1937, was constructed to supply supplemental irrigation water for a net irrigable area of about 75,000 acres of land under the Uncompahgre project, Colorado. Lands under the project lie in Montrose and Delta Counties, on each side of the Uncompahgre River, after which the project was named.

Reconnaissance surveys were made in 1903 on a number of sites in the area drained by the Gunnison River, including the Taylor Park site. The Taylor Park survey was augmented in 1912 and 1913 by exploring the dam foundation and abutments by diamond drilling and the excavation of test pits.

Final investigations were made during the season of 1934 when various sites were under consideration. Plans and specifications (No. 594) were drawn up and alternate bids were called for the construction of a concrete-arch dam and an earth- and rock-fill dam. Bids were opened at Gunnison on February 18, 1935. The contract was awarded to the Utah-Bechtel-Morrison-Kaiser Co. for the construction of an earth- and rock-fill dam on a low bid of $798,078.50. The low bid for the construction of a concrete dam was $784,742.50. The Government furnished cement, steel, and outlet control equipment, or all materials that went into the completed structure. As the cost for materials in the concrete dam greatly exceeded those for the earth, a saving of $170,000 was made by the construction of the earth-fill dam.

Location

The dam site is located on the Taylor River 20 miles upstream from Almont, Colo. At Almont, the confluence of the Taylor and East Rivers forms the head of the Gunnison River. The site is at the gateway to Taylor Park, where the basin narrows to a canyon. The dam site and reservoir area are in Gunnison County, about 35 miles northeast of the town of Gunnison, the county seat. Stored water from the dam will flow down the Taylor and Gunnison Rivers for an approximate distance of 100 miles to the intake of the Gunnison Tunnel where it will be diverted to canals.

View of dam site from opposite the outlet works.

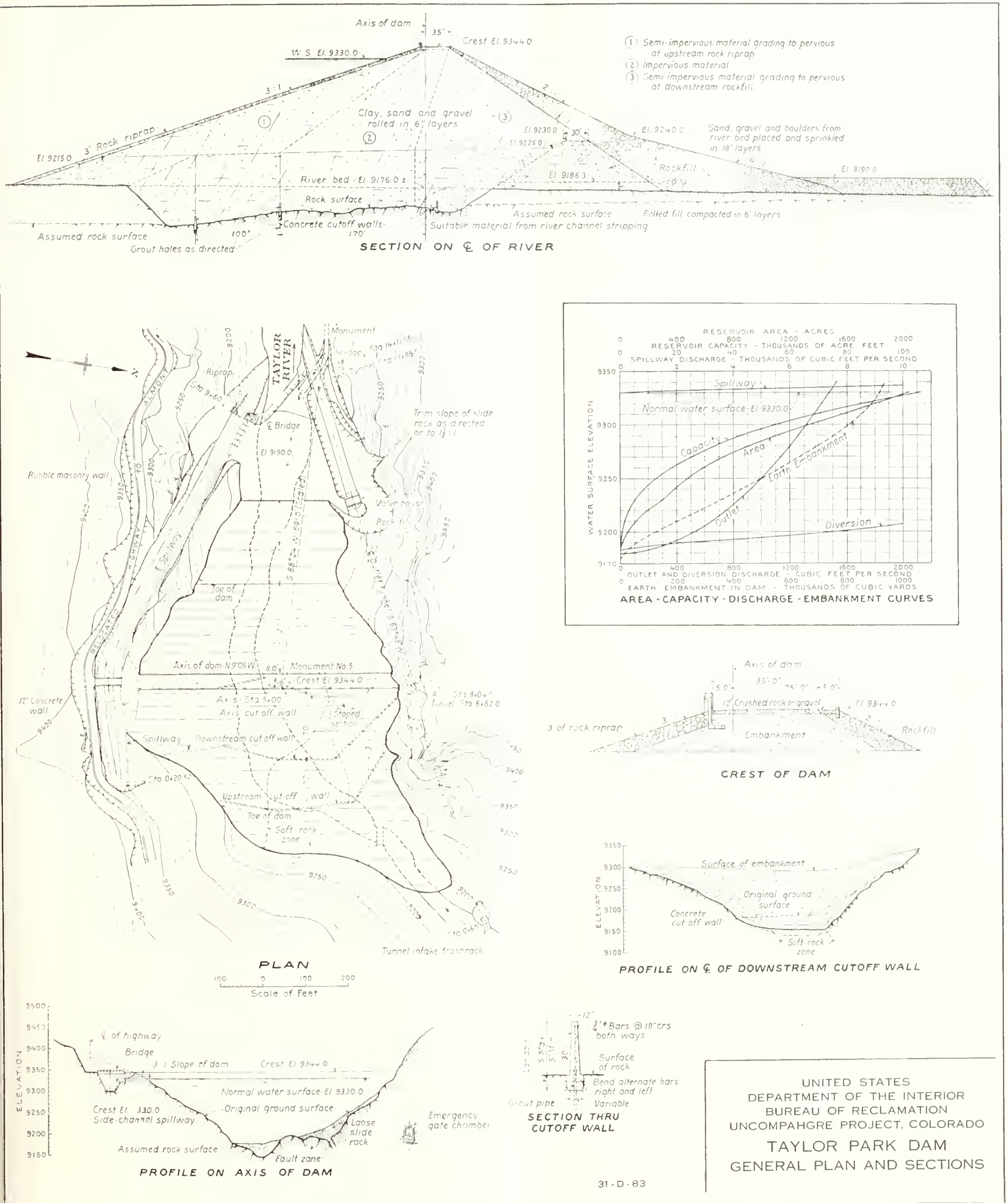
Construction Features and Requirements

Progress was handicapped throughout the construction period because of the isolated location of the project, short construction season, and severe weather conditions through much of the year.

Construction of the project was authorized by the National Industrial Recovery Act of June 16, 1933, under which the Public Works Administration provided an appropriation of $2,000,000 for the project. A contract dated May 31, 1934, was entered into between the United States and the Uncompahgre Water Users Association, providing for the construction of the dam and for repayment of allotted funds to the Government. The association is to pay the United States the total cost of the dam and appurtenant works in 40 annual installments, beginning January 15, of the year following the year in which the Secretary, by notice dated at least 6 months prior thereto, announces that works have been completed, and subsequent installments on January 15 each year thereafter. The first 10 installments are to be $1\frac{1}{2}$ percent, next 10 each $2\frac{1}{2}$ percent, and the next 20 each 3 percent of the total cost.

The principal features involved in the construction of the dam were the earth and rock embankment across the channel of Taylor River, a concrete-lined tunnel, a reinforced concrete valve house and outlet works, a concrete-lined, open-channel spillway, and a permanent roadway. The embankment, which is 616 feet across the crest at elevation, 9,344, rises 166 feet above the original river bed and 206 feet above the lowest point in the foundation, and is approximately 1,000 feet thick through the base. The upstream slope of the earth embankment is 3 : 1, and is covered by a 3-foot layer of rock riprap. The downstream slope is $1\frac{1}{2}$: 1, and is backed by a rock-fill on a slope of 2 : 1 from the crest to elevation 9,240 and then on a 4 : 1 slope from this elevation to a long level section at elevation 9,190. (Refer to General Plan and Section Print No. 31–D–83.)

RESERVOIR.—The dam will create a reservoir with a capacity of 106,230 acre-feet at elevation 9,330, the crest elevation of the spillway weir. The reservoir at maximum water surface level covers 2,033 acres, having a maximum length and width of 3.5 and 1.8 miles,



UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
UNCOMPAHGRE PROJECT, COLORADO
TAYLOR PARK DAM
GENERAL PLAN AND SECTIONS

respectively. The entire reservoir area was free from trees and shrubs of sufficient stature to necessitate clearing.

Principal quantities involved in the construction of Taylor Park Dam according to estimate dated December 17, 1937, follow:

Stripping dam foundation for embankment	cubic yards	141,505
Earth embankment	do	937,314
Rock fill, downstream slope	do	142,115
Riprap, upstream slope	do	26,202
Tunnel excavation	do	6,081
Tunnel concrete	do	1,719
Cut-off wall concrete, dam foundation	do	1,476
Spillway excavation (common)	do	25,198
Spillway excavation (rock)	do	47,513
Spillway concrete	do	4,675
Road excavation (common)	do	31,166
Road excavation (rock)	do	22,343
Drilling grout holes (3 items)	lin. feet	16,667
Cement for grout	sacks	27,312

Diversion tunnel.—On May 1, 1935, the contractor started the excavation of the outlet tunnel anticipating its completion in about 40 days. Progress was normal at the inlet end of the tunnel but serious difficulties were encountered at the outlet end. Work proceeded very slowly due to the fractured rock and to frost in the talus materials which overlay the outlet portal, varying in depth from 0 to 40 feet. Many methods were tried to remove the frozen material but all proved ineffective. Material encountered within certain areas of the tunnel was irregularly shattered and seamy, somewhat inclined to slip and cause considerable overbreakage. Excavation was completed October 12, 1935. The work of placing concrete in the tunnel was begun September 28, 1935, and continued until December 8, 1935, when all tunnel concrete (except the plug and side walls below elevation 9,190.9 of the gate chamber and 25 feet of regular tunnel section at the outlet end) had been placed. The tunnel is reinforced for a short distance at each end, through the gate chamber, and in the transition sections. The average required thickness for concrete in the 10-foot horseshoe section, upstream from the gate chamber, is 12 inches. Below the gate chamber, in the 11½-foot section, the average required thickness is 15 inches. Variations exceeding these thicknesses throughout the tunnel were frequent, due to overbreakage.

The concrete-mixing plant was constructed over the inlet of the tunnel. Concrete was dumped by gravity into a hopper which emptied into a bucket suspended from a monorail running the full length of the tunnel. The concrete was then dumped onto platforms and shoveled into the forms through a double line of four doors on each side of the tunnel, equally spaced along the 40-foot section of concrete forms. When the concrete was placed up to the bottom of the top set of doors, slightly above the spring line of the tunnel, hand shoveling was replaced by mechanical placement, which completed the remainder of the section.

View from the cliff above permanent cottage. Dormitory at lower right.

During the late fall of 1937, the concrete-mixing plant was moved to the tunnel outlet, while the concrete was placed in the gate-chamber plug, the last 25 feet of tunnel, and the valve house. Transportation of concrete from the mixing plant to the forms was by pumping method, through a 7-inch pipe line.

The gravel pit and processing plant were located in the reservoir area adjacent to the contractor's camp, about 4,000 feet upstream from the inlet portal of the tunnel.

To insure full placement of concrete in the arch of the tunnel, specifications required the contractor to fill all existing voids by the grouting method. He completed this requirement in the spring of 1936, using regular grouting equipment and methods, with an average water-cement ratio of 0.75, by volume. Due to extreme tightness of concrete against the rock and refusal of many holes to take grout, neat cement and water were used without other ingredients being added.

Tunnel grouting was pursued with regular methods and equipment and no unusual problems were encountered. Water-cement ratios varied from 0.75 to 6.0, by volume, holding pressures ranging from 20 to 150 pounds per square inch. Tunnel grouting was completed during the late fall of 1937 requiring a total of 1,816 sacks of cement, placed in 1,784 linear feet of drilled holes.

Two control gates, one 4 by 5 feet and the other 5 by 6 feet, were encased in the concrete plug at the end of the pressure tunnel section.

The plug was placed in the fall of 1937, after the water had been shut off at the tunnel intake trashrack structure in the following manner: A scaffold constructed of heavy logs was erected directly over the double compartment openings from the trashrack to the tunnel. Each opening has a set of 12-inch angle-iron grooves and in these grooves were placed 10- by 10-inch logs, which formed a bulkhead. A 4- by 4-inch opening was provided in each bulkhead and was equipped with a removable gate from which an attached wire reached to the top of the scaffold.

When placement of the concrete plug was completed, the high-pressure control gates were closed and the 4-inch gates opened, thus admitting water into the tunnel and equalizing the pressure on the bulkheads. The hoist had been attached to the bulkhead so as to permit pulling a few of the logs at a time, but the equalization of pressure made it possible to remove the entire bulkhead at once, exerting a minimum of pressure on the hoist.

Water released through the permanent gates flows into two pressure pipe lines, respectively 57 and 72 inches in diameter, which run through the lower section of the tunnel to the valve house. The water flow is regulated at the valve house by two 48-inch interior differential needle valves. The valve house is constructed of reinforced concrete

and has a specially constructed roof section, placed directly under a vertical cliff and designed to withstand the possibility of a shock from rock fragments.

STRIPPING FOUNDATION AND ABUTMENTS.—Stripping, involving a few thousand cubic yards, was accomplished during the season of 1935 along the north abutment toward the dam axis, during the time the diversion tunnel was being excavated.

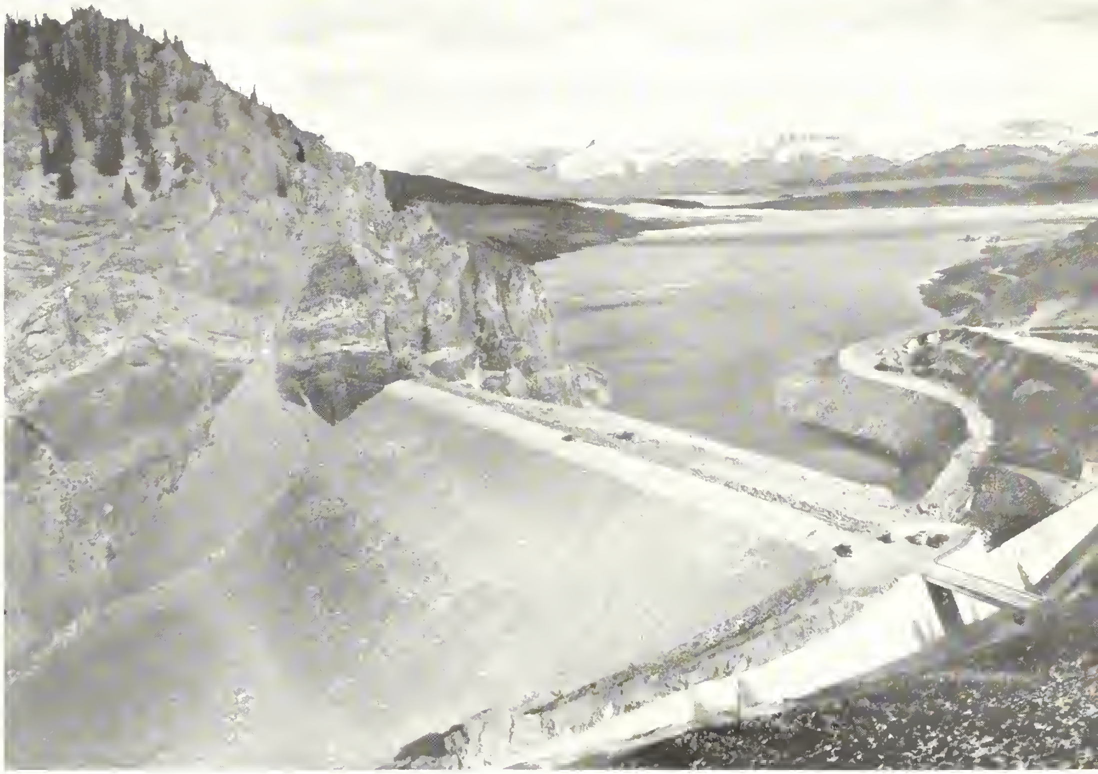
Stripping the abutments was started with manual labor, but since progress was slow, the stripping method was changed to sluicing in the latter part of September 1935. Sluicing water was pumped from the river by a 4-inch centrifugal pump and piped to the abutment where it discharged into a fire hose, with a nozzle attached and controlled by two men. The flexibility of the fire hose allowed the coverage of a considerable area without changing the pipe line. Due to cold weather, sluicing and stripping were discontinued for the season the first part of November.

Stripping was resumed early in the spring of 1936, after the river had been diverted through the tunnel. Activity was centered upon the hauling of river-bed material consisting of sand, gravel, boulders, and talus from the dam foundation and abutments upstream from the dam axis and placing it in the sand, gravel, and boulder section located in the downstream toe of the earth fill. Up to elevation 9,186.3 this material was placed in regular layers and compacted to a thickness of 6 inches. Rocks exceeding 5 inches in dimension were removed and the layers were rolled 12 times. From elevation 9,186.3 to the finished elevation of 9,230, the same material was placed in 18-inch layers and compacted by sluicing, with satisfactory results. Boulders in excess of 12 inches maximum dimension were removed.

Foundation stripping was started at the upstream toe of the dam and continued downstream to the sand, gravel, and boulder section as shown on drawing No. 31–D 83. Stripping operations proceeded somewhat satisfactorily until a deep gully was encountered, near the dam axis. This gully was about 150 feet long and too narrow to permit the use of a power shovel or dragline, thus necessitating the use of a bulldozer. A dragline was used, to some advantage, at each end of the gulley. Between lines extending across the dam foundation, which are 340 feet upstream and 75 feet downstream, the foundation and abutments were stripped to rock. Much of the contractor's heavy equipment was used throughout the stripping operations.

Placement of the rock-fill section of the dam was carried on concurrently with the placement of the sand, gravel, and boulder section of the embankment and later with the earthfill. Rock was obtained chiefly from the spillway and road excavation, which had been left in stock piles. All material in the rock-fill section was placed in 3-foot layers and sluiced with water.

Rock for the 3-foot layer of riprap on the



Earth- and rock-fill complete except parapet wall, lower road, and spillway.

upstream face of the embankment was transported to the fill in trucks which were lowered down the 3 : 1 slope and hauled back up by a cable attached to a power shovel with the dipper stick removed. The rock was spread by bulldozers, and the face was finally dressed by hand labor.

UNWATERING FOUNDATION.—The river was diverted through the tunnel on May 13, 1936, by the construction of a cofferdam at the upstream toe of the embankment. Unwatering the foundation was started so stripping operations could proceed. To lower the water in the area which had been excavated the previous season, it was necessary to establish a pump station that would recede with the water. A pontoon barge large enough to support two pumps was built, using oil barrels for a base. A foot valve extended about 1 foot below the bottom of the barge. Two pumps placed on this barge started pumping water on May 19, 1936, with a capacity of 63,000 gallons per hour, and with continuous pumping the hole was unwatered by June 1, 1936. As the water level dropped and as stripping progressed, increased flow of water into the dam foundation area necessitated the installation of two more pumps. The water continued to increase in quantity to the extent that it was necessary to pump approximately 70,000 gallons per hour, until grouting began to decrease the flow. Nearly 400,000,000 gallons of water were pumped from the dam area in 1936. Grouting procedure was dictated by the action of the shifting streams of water entering the dam foundation surface, with no specified program, which was undoubtedly the only procedure that could be used when the underground water channels were changed from day to day as the grout program advanced. In some instances flowing water was followed up the nearly vertical cliffs approximately 30 feet, requiring several grout connections before the water entering the foundation could be stopped.

Foundation grouting was begun June 26, 1936. Holes were drilled with diamond drills to various depths, not more than 25 feet, then blanket-grouted in an effort to seal the surface. After the surface was grouted the same holes in practically all cases were drilled to greater depths and grouted. Thirteen thousand six hundred and six linear feet of grout holes were drilled in the dam foundation and 24,290 sacks of cement were used for grouting. As a result, the flow of water into the foundation was reduced to occasional weeps of negligible consequence. Water-cement ratios varied from 0.66 to 6.0, by volume. Grouting pressures varied from 10 to 225 pounds per square inch. Foundation grouting was practically completed during 1936; the last few holes were drilled and grouted during the season of 1937.

CONCRETE CUT-OFF WALLS.—Three concrete cut-off walls were constructed across the foundation and extended up the abutments converging toward the axis. The first wall is 270 feet and the second wall is 170 feet upstream from the axis, and the axis wall zigzags somewhat across the dam axis line. Excavation, accomplished with jackhammer and paving breakers, was slow since it was

specified that the trenches were to be line-drilled and excavated without the use of powder. Because of the fractured nature of most of the rock, excavation to neat lines was impossible. The base was 3 by 3 feet, except through a zone in the foundation where soft rock was encountered, and here the wall was placed to a depth of about 12 feet. The wall extended 10 feet above the base with a thickness of 12 inches at the top, then battered to 20 inches at the base. Wall sections were placed monolithically, except for the sections with deep subwalls. The concrete wall is reinforced by 3/4-inch round bars at 18-inch centers both ways.

EARTH PLACEMENT.—On August 8, 1936, grouting and clean-up of the section above the upstream cut-off wall had been completed and earth placement started. Rock pockets and crevices were filled by power tamping and consequently placement was slow until the foundation was covered. There was a certain amount of water percolating through the upstream cofferdam and underneath the porous river-bed material, between the rock fill and the sand, gravel, and boulder section of the dam. The water was accumulated into sumps, one placed at each toe of the earth fill, and from which the water was pumped back into the river. The water level in these sumps was kept to a minimum until the earth embankment was placed approximately 12 feet above the river level. The timber cribbing was then removed from the interior of the sumps and they were filled with the best clay material from the borrow pit. Compaction was accomplished by sluicing the layers of earth as they were placed in the sumps.

As the foundation was not ready for earth placement below the upstream cut-off wall, the contractor was restricted to the section above this wall until August 12. During this time he was allowed to build the embankment 2 1/2 feet above bedrock adjacent to the concrete wall and to continue to the upstream toe on a 10:1 slope. The area below the cut-off wall could be reached only by a narrow gorge large enough for only one piece of equipment at a time, and progress was slow until the embankment of this section was placed above the wall.

All earth placed to elevation 9,180 was the best clay material, of which about 75 percent passed the 1/4-inch screen. Above this elevation the clay material was confined to the clay core of the embankment between the middle and axis cut-off walls. Embankment material was dumped in windrows running parallel to the dam axis. Spreading was accomplished by the use of tractors with bulldozer attachments. During the first season, the sheep's-foot rollers used for compaction were ballasted with water. Prior to starting operations in 1937, the rollers were filled with a ballast of wet sand giving a unit knob pressure of approximately 470 pounds per square inch for four knobs in one row.

After foundation stripping was completed and the embankment was placed to an elevation of 9,190, an examination of the abutment walls showed seams and crevices which could not be effectively filled by power tamping. A revision was made in the construction contract, requiring the contractor to puddle the earth as it was placed along the rock abutments, which became effective September 26, 1936. Puddling material next to the rock abutments was continued throughout the remaining construction period, and material placed adjacent to the concrete cut-off walls was compacted by power tamping, according to the original prescribed method. Puddling was accomplished by leaving a trench along the rock abutments not exceeding two feet in width and approximately 1 foot in depth. The best clay material obtainable was dumped next to the rock abutments and spread by bulldozers. The trench was filled with water from a hose, sluicing the fine material into the rock seams. As the earth was shoveled into the trench it was booted until the clay became plastic and easily forced into the cracks and crevices. After the puddle crew had completed its work, sheep's-foot rollers passed over the material adjoining the trench, adding to the pressure of the puddled area. As the embankment was raised, the weight of the material above added still more pressure and forced the plastic mud farther into the cracks of the abutments. This method proved very satisfactory in filling the voids and crevices of the fractured abutments.

Starting earth-fill between first and second cut-off walls.

SPILLWAY.—The spillway is located on the left abutment with the intake section of the structure approximately 231 feet upstream from the dam axis. Adjacent to and downstream from the draw near the axis of the dam, a natural rock ledge extends into the dam section forming an advantageous location for the construction of the spillway intake.

The structure consists of a reinforced, concrete-lined, open channel, with an overflow-type weir crest, 180 feet long. The designed capacity is 10,000 cubic feet per second with a water depth of 6 feet over the weir.

A steel girder bridge with an 8-inch concrete deck crosses the spillway on the dam axis line, its elevation being in accordance with the crest elevation of the dam, which is 9,344.

An abrupt 8-foot rise in the floor marks the change from the intake to the chute section of the spillway. This intake pool is adequately drained with an 8-inch tile drain. The chute section extends down the abutment to river level. The upper 166 feet of the chute is on a grade of 0.20, the next 288 feet on a grade of 0.25, the next 190 feet on a slope of 0.34, from which point a vertical curve changes this slope to horizontal. As the river bed is of stable rock formation, no provision was made to dissipate the energy of the water entering the river. The total drop from maximum reservoir water surface level to tail water is 149 feet.

Excavation for the spillway structure was difficult, due to the fractured rock which lay in cubical blocks with zones of fractures lying in every direction. Excavation to neat lines was impossible in this formation. Drilling was done by jackhammers and wagon drills.

The maximum cut through the rock ledge was 85 feet, and through the full length of the spillway the cut averaged approximately 60 feet. Throughout the full length of the spillway, the structure was placed on rock foundation. Grouting was required under the intake-weir section and the outlet stilling basin to insure a stable foundation and to eliminate possible danger from hydrostatic pressure under the concrete floor.

A layer of porous concrete, ranging in thickness from 4 to 24 inches, was placed over the spillway intake floor and extended downstream approximately 160 feet under the chute floor. Four-inch vertical drains encased in porous concrete were placed every 20 feet in the spillway lining, running from the floor of the spillway to within 2 feet of the top of the lining, except in the back-filled sections. The porous concrete in the floor was covered with a heavy mortar paste approximately ½ inch thick. Over this was placed a layer of concrete 15 inches thick, providing a floor for the spillway.

Concrete was placed in the intake section of the spillway during the season of 1936 and the early part of 1937 by a cableway from which was suspended a ½-yard bucket. During the season of 1937, placement was made for the remainder of the structure by using a concrete pump. Concrete from the high line was dumped into a hopper and then transported in concrete buggies to the forms, where it was either placed directly or carried to the point of placement through chutes or tapered elephant trunks. The concrete placed by the pump was dumped directly into the forms, except on occasions when the drop was excessive and short chutes or elephant trunks were used.

A field laboratory was established during the summer of 1935 and equipment installed for making practically all routine tests on earth and concrete materials. Test results show that the average earth embankment dry density on the minus one-fourth material was approximately 110 pounds per cubic foot or even greater when rock larger than the ¼ inch was considered.

Optimum moisture for maximum dry density on most of the material was established at 17 percent. Earth was placed in the embankment at a very small variation from the laboratory optimum moisture. The only water added on the fill was to take care of evaporation, as the borrow pit contained sufficient moisture for placing requirements.

The remaining construction of the indicators will be completed during the spring of 1938.

Parapet and curb walls.—Settlement plugs covering the downstream face of the dam were placed during the late fall of 1937. Line and grade were established on each plug. A definite record will be kept showing the movement of these plugs by settlement or displacement. When it is definitely determined that the initial settlement or displacement has ceased, the parapet and curb walls will be constructed as shown on drawing No. 31-D-83.

Progress of Investigations of Projects

THE following is a brief summary of the engineering investigations during March 1938:

California, Kings River-Pine Flat project.—Field work was discontinued during the month.

Colorado, Blue River transmountain diversion.—A topographic survey of the Ute Peak and Alameda-Hogback tunnel lines was completed, and studies made of use of water in South Platte Valley.

Colorado Big Thompson transmountain Diversion. Power studies were continued and negotiations of repayment contract with Northern Colorado Water Conservation District were in progress.

Colorado, Eastern Slope surveys.—Water supply studies were continued of Cherry Creek, North Republican River, and Apishapa projects.

Colorado, Western Slope surveys.—Water supply studies were continued of the Collbran, La Plata, Silt, and Mancos projects.

Idaho, Cabinet Gorge project.—Diamond drilling at the Cabinet Gorge dam site was completed, nine holes having been drilled; power market was investigated and preliminary studies for design of dam were in progress.

Southwest Idaho investigations.—Studies were continued of water supply in the Boise, Salmon, Snake, and Weiser River watersheds, and preparation of report of the Payette watershed was begun.

Snake River Storage-South Fork.—Diamond drilling was begun at the Burns Creek dam site.

Montana, Gallatin Valley project.—Additional studies were begun of power development, irrigation, and return flow.

Montana, Marias project.—Investigation of the project was begun, including reconnaissance of dam sites and irrigable areas.

Nebraska.—Reconnaissance of the Bostwick project was begun and survey of reservoir site Rope Creek, near Alma, made; the report of the Mirage Flats project was completed.

North Dakota.—The report of the Buford-Trenton project was nearly completed.

Oklahoma, Kenton project.—A map of the Garrett dam site was completed and a report of project is in preparation.

Oregon, Canby project.—A report is in preparation of a pumping project northwest of Canby.

Oregon, Deschutes project.—A supplementary report was in preparation of the diversion to Odell Lake.

Oregon, Grande Ronde project.—Maps were prepared and water supply studies continued for the report which is in preparation.

South Dakota.—The report of the Shadehill project was completed and a report of the Angostura project was in preparation.

Utah.—Drilling at Scofield dam site, Price River project was completed, and water supply studies were continued of Blue Bench and Gooseberry projects.

Utah-Idaho-Wyoming.—Water supply studies were continued of the Green River-Bear River project, and control data for the aerial mosaic of Bear River Valley obtained.

Colorado River Basin.—Mapping and land classification of areas on the Vermillion project and in Clark and Vernal Ashley Valleys and along the Virgin River and Ash Creek were continued.

SILT *in* *Elephant Butte Reservoir*[1]

ELEPHANT BUTTE RESERVOIR on the Rio Grande has received an average of 18,634 acre-feet of sediment per year for the 20¼ years since storage began, representing an average annual storage loss of 0.68 percent. Since it is estimated that less than 5,000 acre-feet or 0.75 percent of the total incoming sediment has bypassed the dam (as a result of underflow currents), this represents very closely the average net output of erosional debris from the watershed of 26,312 square miles. The annual rate of silting declined during the period 1925–35 from a previous average of approximately 20,000 acre-feet per year. This has been due solely to decrease in an average annual inflow, the sediment content of the inflow having maintained a strikingly uniform average of 1.65 percent, by volume. San Carlos Reservoir on the Gila River, Arizona, has silted at an average annual rate of 0.47 percent a year since its completion. Both of these reservoirs show striking evidence of existence of the underflow phenomena which is now a subject of investigation by several agencies and is under special consideration by the committee on density currents of the National Research Council. The total original capacity of reservoir was 2,638,860 acre-feet; the amount of silt is 365,186 acre-feet, making the total depletion of storage to date 13.84 percent.

[1] From "Sedimentation Studies" by Carl B. Brown, for Soil Conservation Service.

Associated Farmers of California

THE organization of a branch of the Associated Farmers of California was recently perfected in Glenn County (Orland project), California, with the purpose of protecting the farmers from the operations of racketeers and radical elements. The association started its growth in the southern part of the State several years ago and has been gaining strength rapidly.

The Desert Shall Bloom Again

By RICHARD J. LOUDON, *Inspector, Coulee Dam, Washington*

TALL, waving bunchgrass brushed the stirrups of Marcus Whitman on his memorable ride from the Pacific northwest to the Nation's Capital early in the past century. Years previous, in 1804, the horses of Lewis and Clark waxed fat on this same, luxuriant cover. Father DeSmet in 1840 and Brigham Young in 1847 were thankful for this abundant feed which made possible their hazardous journeys into the West.

These brave, historic pioneers little dreamed that the foremost emblem of the civilization they sponsored, the plow, was to serve not only as an implement of construction but of destruction as well.

The bunchgrass is gone now. Retreating before the onslaughts of advancing civilization, it has followed the buffalo into extinction. Farming, overgrazing, floods, and drought exacted heavy toll for generations in that area west of the 100th meridian. In this area, which embraces the western one-third of the United States, the results are too apparent and too well known to require lengthy comment here. It is sufficient to point out that where overgrazing has destroyed the natural cover, or where dry farming has long been practised in these arid or semiarid regions of the West, destructive erosion of the precious topsoils has invariably resulted.

It would be purposeless to attempt here to fix responsibility for these conditions—to say that any man or any group were definitely to blame. Every farmer, every stockman of past generations was an innocent contributor. The agents of erosion—wind, water, and widely varying temperatures—did the rest. It is rather more to the point to indicate here the recognition of these conditions by far seeing individuals, by the various States and by the Nation and what is of greater importance, the application of the remedy.

Pioneers of the West

Dame Nature, often profligate, always inconstant, offered rich rewards to those hardy pioneers who first settled on the Great Plains, in the Oregon Territory and in California. The majority of these folk were traders, trappers, miners, and stockmen. Only a few were tillers of the soil. Later, however, slowly at first, then in ever-growing numbers, this latter group increased as the westward tide of migration broadened the first dimly blazed trail and faint track that led through the wilderness. Braving the dangers and discomforts of a little-known land, driven by human necessity and that restless urge of pioneer blood that has made America great, these ancestors of ours sought neither gold nor glory, but only the opportunity of a fresh start in a new and fertile land; opportunity to till the soil and establish homes. In so doing they laid the solid foundations of an empire—the West of today.

It was inevitable that this growing tide of homeseekers should eventually exhaust the available supply of rich bottom lands along the streams and the cheaply irrigable, adjacent slopes. The rich Great Plains region was already dotted with farms in spite of the variable rainfall which was and still is less than 20 inches annually in that portion lying west of the 100th meridian.

Farther west, the river valleys became thickly populated and newer settlers were crowded farther into the arid deserts and onto the high plateaus. It was then that water, for irrigation and domestic purposes, was recognized as a definite need of primary importance if the growth and development of agriculture and its many dependent pursuits were to continue in the West.

Irrigation was not new to the world. Indeed, it was a practice hoary with age along the Nile, when Mark Anthony wooed Cleopatra; it was ancient in the river valleys of China when Marco Polo visited the emperor and it was not without precedent in our own western America. History records that the first irrigation system used by English speaking people in the United States was established by the followers of Brigham Young, near the present site of Salt Lake City, shortly after they arrived in Utah.

It was not surprising then that the people of the arid West turned to irrigation as the solution for their development problem. It must be noted, however, that neither the West nor the Nation accepted the remedy in one swallow. By many the medicine was regarded as being worse than the disease. In general, the opponents of reclamation and conservation were usually the opponents of all western development, while the proponents were the citizens of the West and those few statesmen, State and Federal officials who recognized the necessity for the conservation and wise usage of the West's primary resource—its water.

The Salt River Desert.

An outgrowth of human needs in an arid land and with only faith and determination to advance it, irrigation became established in the West. It must not be assumed, however, that these early efforts were without failure. It was inevitable that there should be some mortality among the projects initiated. But few victories are won without some losses. In general, laying the foundations for this new and distinct type of agriculture, irrigation farming, was successful. Just how successful is significantly demonstrated by the fact that in 1855, at Fort Laramie, Wyo., a few Mexican families irrigated their gardens with water from the Platte River—today almost a million acres of land are irrigated along this same stream.

It was natural that the first irrigation projects were those that could be most easily and cheaply constructed. These were built by individuals, to water their own lands. Later, groups of landowners, drawn together by a common need, established more extensive systems. As the results became more widely known sentiment grew in favor of this old, yet new, method of making several blades of grass grow where only one, or possibly none, grew before.

However, in spite of the efforts of such champions as Maj. John W. Powell, Director of the United States Geological Survey, who pleaded the cause of irrigation in the late eighties, and President Theodore Roosevelt, stanch friend of conservation and reclamation, it was not until after the turn of the century that the Federal Government became definitely committed to the cause of reclamation.

At that time, June 17, 1902, the approval of the Reclamation Act created the Bureau of Reclamation and thus set in motion a self-liquidating program for the development of our arid and semiarid States.

Construction Results

The success of this program for the past 35 years speaks for itself. In a period of little more than a third of a century, the Bureau of Reclamation has constructed 138 dams and nearly 20,000 miles of canals for the irrigation of 3,000,000 acres of land. Considered from the standpoint of human values, as well as material, it has accomplished more than this—it has created a vast empire of 49,000 well-watered farms, populated by 211,000 people; 257 towns with a combined population of 654,000, towns containing 859 schools, 996 churches, and 106 banks with a capital stock in excess of $13,000,000. It has built a producing empire, peopled with happy, prosperous citizens who spend, reliable statistics show, 75 to 80 percent of their incomes for the purchase of commodities and manufactured goods produced in the industrial sections of the United States, farmers who pay taxes and contribute materially to the general prosperity of the Nation.

In addition to the far-reaching benefits resulting from the conservation and utilization of water, there are others just as important being realized from the stabilization of the West's greatest industry, the livestock. Although it is true that the Forest Service has for years limited the number of head of stock that could be grazed in the national forests, more recently the Division of Grazing of the Department of the Interior, authorized under the Taylor Grazing Act of 1934, has taken steps to guard against misuse and depletion of the 165,000,000 acres of federally owned pasture under its jurisdiction.

Salt River Valley reclaimed from desert land.

Already, since the enactment of this wise legislation, overgrazing has been eliminated to a large extent. It is obvious that this form of conservation, by its close regulation of our public ranges, will halt in a large measure destructive erosion by encouraging the growth of natural cover. Coupled with reforestation this will go a long way toward the eventual restoration of our all-important watersheds, from whence comes the major portion of our available water supplies.

Prevention of fire and erosion, practice of reclamation, flood control, and reforestation are the aims of our Government departments charged with those responsibilities, and through them the beauty, productivity, and prosperity of the West can be increased and preserved.

Though the bunchgrass is virtually extinct, in the western farming areas it has been replaced a thousandfold, through the medium of irrigation, with abundant crops of every variety. In these areas where irrigation is firmly established, green fields, sturdy productive orchards, and attractive homes present a happy contrast with the dry, desolate, treeless wastes which sometimes border the irrigated districts. Such proof leaves little doubt as to the wisdom of reclaiming the desert for human needs.

Benefiting the entire Nation, reclamation has proven economically sound, feasible in every aspect, self liquidating, and humanly desirable, in the past. Today, reclamation as a national policy is of even greater importance. Today a new tide of "emigrants" are raising the dust of the Oregon Trail on their westward march. To these modern homeseekers—erstwhile tenant farmers from the East and South, flood refugees from beyond the Mississippi and disheartened but unbeaten drought sufferers from the "dust bowl"—the West is still the Promised Land. The West must be prepared to receive and welcome these unfortunate but capable tillers of the soil. Water is the answer, for indeed, to the West, water is life and with it the desert shall bloom again.

New Arizona Highway to Boulder Dam

THE opening on April 24 of the new Kingman Highway between Kingman, Ariz., and Las Vegas, Nev., makes it possible for motorists to reach Boulder Dam from either of two continental highways, U S 91 and U S 66.

The new Kingman road is a fine graded, hard-surfaced highway, and is the last link connecting the two transcontinental routes. Boulder Dam serves as its bridge across the Colorado River.

A. R. Golzé on Field Trip

A. R. Golze, Supervising Engineer, CCC, left his official post in Washington early in May to visit the Bureau's CCC camps, Reclamation offices, and office of the liaison officers. Mr. Golze expects to return to Washington in June.

Milestones for Shoshone Irrigation District

By M. P. McLAUGHLIN, *Superintendent*

THE YEAR 1937 marked two momentous anniversaries in our community—our 30th anniversary as an irrigation project and our 10th anniversary as an irrigation district. These swiftly passing years chronicle the building and growth of a great irrigation district. Year by year as a community and as individuals we have achieved new goals. From the earliest days Shoshone people have reared not alone a progressive agriculture, profitable industries, modern schools and roads, civic structures, and attractive homes, but cherished traditions of courageous pioneering, civic spirit, hospitality, enterprise, and vision.

History writes its record in the day's and the year's work and usually we are too occupied to view our own activities and those of our neighbors with much awe. So as the chapter for 1937 closes on the Garland division of the Shoshone project, it is a story of day-to-day accomplishments, civic celebrations, community good times, and the ever-pioneering spirit of Shoshone people.

In spite of adverse weather conditions and the disappointment of lower priced crop returns than were anticipated, 1937 brought a good measure of prosperity to most of our people. Considerable new building was in progress, employment had improved, and a full calendar of good times was thoroughly enjoyed.

The most important construction of the year was the new Federal post office erected in Powell at an approximate cost of $88,000. This improvement had long been desired and a crowd of several hundred people attended the dedication on December 17. The Post Office Department moved in shortly thereafter and now occupies the entire building except for the offices reserved in the basement for the County Agent and the Bureau of Reclamation.

Project Improvement

Rural electrification plans were made early in the spring. A considerable part of the project has had electricity for a number of years. The new plans will make possible the electrification of additional sections of the project, lightening farm labor and bringing added enjoyment to the family on more than 200 farms.

A large number of attractive homes were constructed on the division. Many homes over the project were improved by remodeling, enlarging, painting, and repairing. During the winter a new apartment house was built and several small tourist cabins were constructed to accommodate summer tourists.

Considerable industrial building took place. One seed company constructed a new bean mill and installed new milling equipment and picking machines. Another seed company enlarged its storage capacity and two new bean mills were added to the present plants. A third company more than doubled the size of its mill to provide for picking rooms, warehouse, and bins. An implement concern made over an old building to serve as a warehouse for its growing business. A freight line company built a new warehouse to serve as a storehouse for merchandise and to store fleets of trucks.

Employment was good. The different seed houses employed more men than in other years owing to the increasing business in the bean and pea industry. One seed company which has many farms under its jurisdiction employed a large number of men to work on these farms. During the winter months they hired about 75 women in the picking rooms of their plant and 25 men in the warehouse. Another seed company also hired men and women for the same purpose though on a smaller scale.

Social Activities

The year was enlivened with a full calendar of social activities. The President's birthday ball again headed the list. The ball was very well attended, the proceeds going to advance a great cause—the help of crippled children all over the country.

The Library Club sponsored a series of card parties during early spring, which gave the ladies of the community an opportunity to get acquainted with newcomers.

The Heart Mountain Rod and Gun Club was reorganized, and turned out to be quite active. The club held several turkey shoots, giving our expert marksmen a chance to show their skill.

The Lions Club did its share of entertaining the public by giving a home-talent show early in the season. This was put on to help the boy scouts.

Another important event of the year was the silver anniversary of the order of the Eastern Star. A banquet was held, which was attended by many members from out of town, together with those residing in Powell. Dancing followed later in the evening. This organization started with 24 members and now has 147 enrolled.

For Armistice the American Legion staged a 3-day carnival. The program included all the old Army games with a few of the more modern amusements added. There was dancing each night. This Armistice carnival was something different and was therefore an outstanding success.

The Farm Bureau was an active organization and met regularly. The 4-H Club was increasingly popular with the youngsters, and enrolled many new members. Three of the girls won national recognition for their cooking and sewing abilities.

During the summer months the high school band gave concerts about every 2 weeks. Baseball again became a favorite pastime for the community. Softball was played nearly every evening by different teams made up of boys and men around the town and country.

Another memorable occasion was a community after-harvest party given by a prominent produce man. The party was given at the Legion Hall and the entire community invited. Moving pictures were shown for the people and the children were entertained by playing games. The evening ended in dancing for both young and old. Lunch was served throughout the evening. This was the first party of its kind ever given in Powell and everyone enjoyed this treat immensely.

In the late summer a Park County Fair was held in Powell. The Governor was the distinguished guest on the opening day and gave a brief talk at the fair grounds. Around 5,000 people were present the first day. The fair lasted 3 days, with a large attendance each day. Many exhibits were on display and prizes were awarded for the best articles. Entertainment at the fair included a carnival, horseracing, a baby show, several acrobatic acts, and many other amusements. The fair was a great success as it was the first of its kind here in Powell, and plans are being made for another fair in 1938 with the end in view of making this an annual event.

Enduring Traditions

As the year 1937 closed—a year that brought full measure of achievement, enjoyment, and responsibility to our people—some of our associates of many years were missing from our midst. It is with deep regret that we record the passing of these friends, many of whom came during the early days of the project. Former residents of Illinois, Wisconsin, Iowa, Missouri, Nebraska, Kentucky, Germany, and Switzerland—these settlers gave their best years to this project and for the most part lived for 20 to 30 years in our community. All played important parts in the development of the district. Their work on the project will be remembered and the enduring traditions they fashioned in their day-to-day contributions to this project will live on in the activities and endeavor of those who carry on in this great American community.

Reduce Costs by Using Home-Grown Foods[1]

PRODUCTS which farmers have to sell have declined more in value in the past few years than have the prices of the products which they must buy. Therefore, it is advisable to utilize a large proportion of goods produced on the farm and use the cash income for purchasing other things needed in the home. With careful planning, every farm family should be able to supply itself with an abundance of food.

The food-production plan outlined in the accompanying table shows how it is possible to provide the foods needed to maintain health and strength.

Other ways in which savings may be accomplished and food costs reduced may be found in these farm suggestions.

Make cheese of surplus milk.—One gallon of milk makes 1 pound of cheese. American cheese can be made in the winter or spring. It can be stored for several months.

Preserve eggs.—Preserve eggs during the spring for use the following winter when the hens are out of production.

Can the "cull" chickens in the fall.—The canning of "cull" chickens is cheaper than feeding them.

Butcher home-grown livestock for meat.—Exchange fresh meat with the neighbors at butchering time to avoid excess canning and curing. Choice cuts may be stored in freezer lockers for fresh summer use.

Use grain products raised on the farm.—Whole wheat and cracked are good foods. Parching wheat for cereal improves flavor. Hominy and cornmeal can be prepared in the home.

Use sorghum and honey for sweets.—These food products can be produced on the farm. One quart of sorghum or honey is equivalent to about 2 pounds of sugar in the diet.

Raise, can, and store fruits and vegetables.—Tomatoes may be used the year around as a substitute for citrus fruits. Can only the vegetables that cannot be stored. Use the pressure cooker for canning. Vegetables that are to be stored should be grown in the fall garden. If a storage cellar is not available, vegetables may be buried in outdoor pits. Apples and pears may be stored or dried. Surplus early apples may be canned.

Provide for the baby.—Vegetable purees canned in small jars will provide health-food for the baby.

Obtain variety in menus.—Add variety to the menus by learning to cook foods in a number of ways.

Save time and fuel by careful planning.—The use of the oven and the pressure cooker in preparing meals will save time and fuel.

Avoid waste.—Prepare foods carefully and in suitable amounts and do not overeat.

FOOD PRODUCTION PLAN FOR FARM FAMILY OF FIVE

Products	Yearly amount for family of five (2 adults–3 children)	How to provide
MILK:		
1 quart per child, 1 pint per adult, daily. Additional milk for cheese, cream, etc.	1,825 quarts—456 gallons. 1 cow—average yield, 410 gallons yearly.	2 cows—have freshen at different seasons—2 to 3 gallons milk per day.
Butter—1/2 to 1 pound weekly per capita	130 to 260 pounds butter.	
EGGS AND POULTRY:		
10 eggs weekly per capita. Chicken served at least once each week.	2,600 eggs from 35 hens (average per hen—75 eggs)	Flock of 50 pullets for eggs and meat supply. Hatch 300 baby chicks each spring. (Chick mortality for Kansas, 15 to 25 percent.)
MEAT:		
Served 6 days per week. Average amount used daily—1/2 pound per adult, 4 ounces per child.	550 pounds: 350 pounds dressed beef	1 beef—700 pounds live weight. (Preference is generally given to younger grades.
	165 pounds pork	2 hogs—200 pounds each, live weight.
Lard and bacon extra	35 pounds lamb	1 sheep—75 pounds live weight.
VEGETABLES:		
At least 2 servings besides potatoes, daily (1 serving equals 1/2 cup.)		
Leafy vegetables should be served at least 3 times weekly	Fresh greens—May 1 to October 15. 16 quarts canned.	200 linear feet greens—divided as desired, according to varieties.
Choose from the following for 1 serving: Spinach. Beet greens. New Zealand spinach. Swiss chard. Other greens.		
Choose from the following 2 servings: Lettuce	Fresh lettuce—March 10 to November 1	100 linear feet (2 plantings). Muslin-covered cold frames help to extend the lettuce season through hot summer months and early spring or winter months.
Cabbage	Fresh cabbage—June 1 to November 1. 100 pounds stored	150 linear feet (2 plantings).
Tomatoes: 4 or more servings weekly for adults. 7 or more servings weekly for children.		
Fresh—8 pounds weekly for 16 weeks	Fresh tomatoes July 1 to October 15	150 linear feet (early planting). 150 linear feet (late planting.)
Canned—at least 5 quarts weekly for 36 weeks	185 quarts canned.	
Other vegetables: 7 servings weekly, selected from the following: Asparagus. Parsnips. Peas. String beans. Carrots. Beets. Cauliflower. Turnips. Others. Sweet corn. Onions.	Fresh vegetables May 7 to October 15 150 pounds stored. 90 quarts canned. 10 pounds dried.	1/2 to 1 1/2 acres, depending upon type of cultivation and relative amount of more widely spaced vegetables. **(See county agricultural agent or home demonstration agent for garden plan.)**
Dried beans or peas 1 serving weekly.	70 pounds	50-foot row.
Potatoes (at least 1 serving daily)	15 bushels (Irish and sweet)	1/4 acre.
FRUIT:		
At least 2 servings daily. Both fruits fresh for 17 weeks 1 stored and 1 canned for 35 weeks	Fresh fruit May 25 to October 1 150 quarts canned. 25 quarts fruit juices. 20 pounds dried. 4 to 6 bushels stored. (Additional fruits for jelly, jams, etc.	3/4 acre containing: 12 apple trees. 50 raspberry bushes. 8 peach trees. 50 blackberry bushes. 4 plum trees. 150 strawberry plants. 9 cherry trees. 8 gooseberry bushes, and 16 grapevines. 15 hills rhubarb.
GRAIN PRODUCTS:		
Bread every meal	485 pounds flour, white and graham: 385 pounds for 575 pounds bread.	
Flour for pastries, etc	100 pounds for pastries, etc.	
Cereal (1 serving daily)	100 pounds cracked wheat and corn meal	Wheat can be cleaned, parched, and cracked for breakfast cereal.

[1] *Reprinted through the courtesy of Kansas State College of Agriculture and Applied Science from Extension Circular 96, by Georgiana H. Smurthwaite, State Home Demonstration Leader.*

Spillway Reconstruction at Mormon Flat Dam

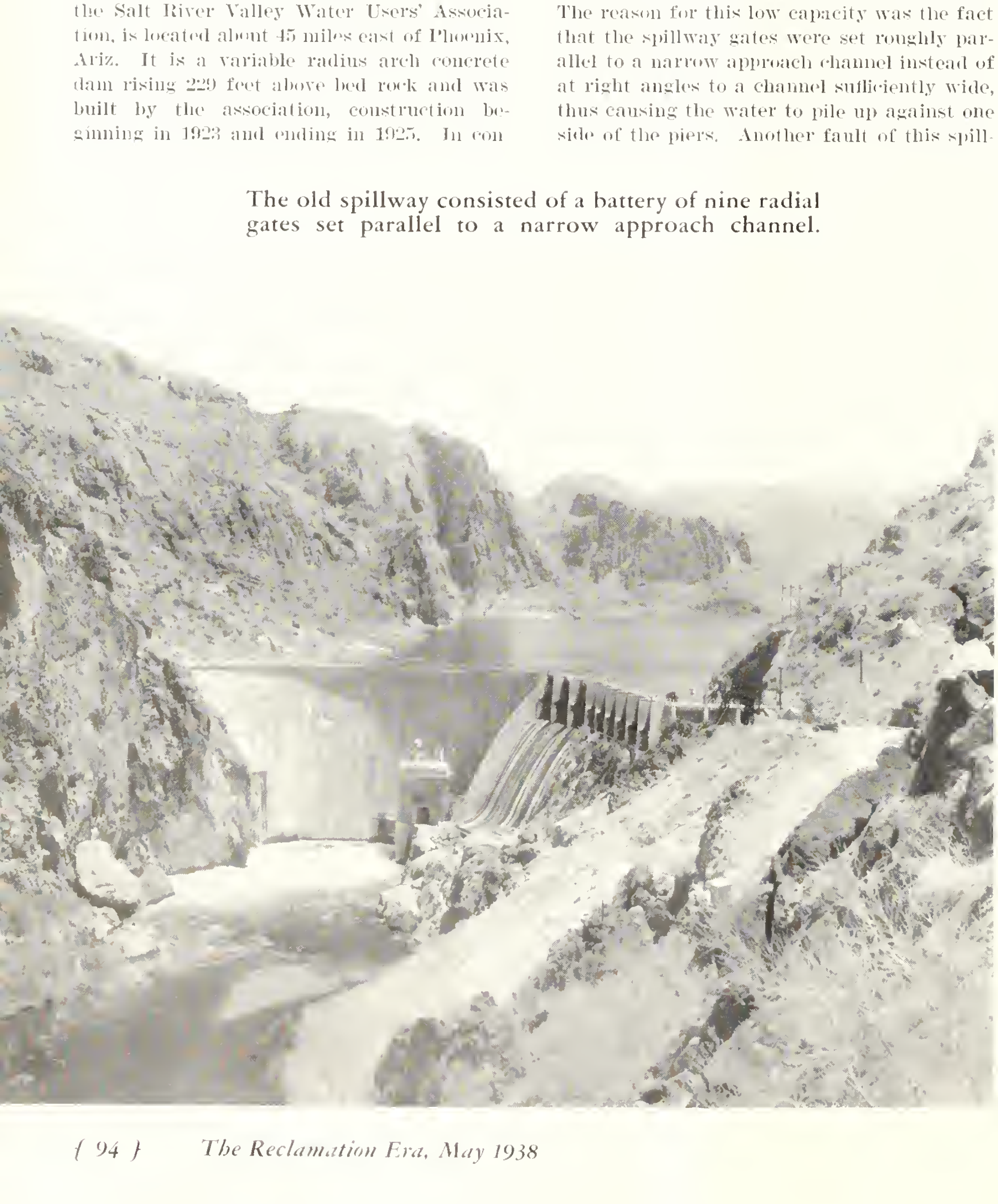
By ALLEN MATTISON, *Engineer, Salt River Project, Bureau of Reclamation*

A PART of the program of increasing the spillway capacity on the four Salt River dams was building what amounts to an entirely new spillway at the Mormon Flat Dam. Although not the largest job on the program, it was by no means of least importance and presented many unusual and difficult problems. The purpose of this article is to point out the necessity for increased spillway capacity, and to discuss some of the problems encountered and how they were met.

Mormon Flat Dam, owned and operated by the Salt River Valley Water Users' Association, is located about 45 miles east of Phoenix, Ariz. It is a variable radius arch concrete dam rising 229 feet above bed rock and was built by the association, construction beginning in 1923 and ending in 1925. In connection with the dam is a power plant of 10,000 horsepower completed in 1926, also built and operated by the association.

The old spillway, over the left abutment, consisted of a battery of 9 radial gates 23 feet high and 27 feet long. These gates normally could be expected safely to pass 150,000 cubic feet per second which is considered necessary on the Salt River. However, it was determined by detailed analysis and checked by model tests that the spillway could pass a maximum of only 90,000 cubic feet per second. The reason for this low capacity was the fact that the spillway gates were set roughly parallel to a narrow approach channel instead of at right angles to a channel sufficiently wide, thus causing the water to pile up against one side of the piers. Another fault of this spillway was the fact that water through it passed so close to the powerhouse that the powerhouse would be put out of commission by the spray.

The old spillway consisted of a battery of nine radial gates set parallel to a narrow approach channel.



After a great deal of research and study of several plans, three or four of which were model-tested by the Denver laboratory, it was decided to replace the radial gate spillway with one of an entirely different type. The plan finally adopted was a tapered and superelevated channel around the left abutment of the dam controlled by two 50- by 50-foot regulating gates. This spillway will pass the required 150,000 cubic feet per second. Also by returning the water to the river channel farther downstream and at a lower elevation, the objectionable feature of spray is eliminated.

The new channel is on a curve which continues roughly on the same radius as the dam. The width at the crest is 100 feet, exclusive of the center pier, and the channel tapers to a width of 45 feet in a length of 450 feet. The elevation of the crest is 60 feet below the top of the dam, and the channel drops 53 feet to its outlet. The sidewall lining is on a quarter to one slope and rises 45 to 50 feet above the floor. The floor is superelevated to compensate for the curvature of the channel. A complete network of tile drains laid in porous concrete is provided under the concrete channel lining to eliminate any possibility of displacement from uplift pressure.

The gate house in which is installed the operating machinery, rising 134 feet above the crest, gives somewhat the appearance of a lift bridge in the raised position. Viewed from certain angles the gatehouse seems to dwarf the dam by comparison.

The first step in opening up the job was to remove the old radial gates, the piers, and all concrete work above the level of the original crest. Since these gates were to be of no further use, they were cut up with acetylene torches and hauled away as junk. In removing old concrete, most of which was heavily reinforced, very effective use was made of a 6,600-pound iron ball swung from a guy derrick set in such a location as to cover the entire spillway. The close proximity of the dam, powerhouse and appurtenant works restricted the use of explosives to light blasting over a comparatively small area of the spillway. Blasting was of very little use in any event, because of the heavy reinforcement in the entire structure. Concrete which could not be removed by use of the ball or blasting had to be taken out with breakers, which was a slow and expensive operation.

Excavation

Excavation of some 70,000 cubic yards of material—mostly rock—from the new spillway channel presented other problems. The rock is a flow breccia and, while comparatively dense, is friable and offered considerable difficulty in drilling, especially when any moisture was present. Here again the use of explosives was a serious problem. Not only was there danger to the powerhouse and outlet works but also a possibility of injuring the abutment to the dam if blasting were too heavy. So great was the concern for the left abutment that a definite limit was placed on the depth of holes, amount of powder and number of holes to a shot. This perhaps had the effect of making the excavation somewhat more expensive than otherwise would seem reasonable but was offset, at least in part, by the very small percentage of overbreak in the completed excavation.

The greater part of the material excavated from the channel was hauled upstream some four or five hundred feet and dumped in the reservoir. A considerable yardage was hauled up the hill to a point near the camp and dumped into a draw to increase the area of storage space which is at a premium on this job. The remainder, some 10,000 cubic yards, was bulldozed into the river channel and later trucked about half a mile downstream, together with about 45,000 cubic yards of waste piles left in the edge of the tailrace channel by the original construction. Final trimming of the channel excavation and cutting of trenches for tile drains was done with breakers.

The nearest aggregate deposit was located about a half mile downstream. Grading of the aggregates in the deposit varied over a wide range, making it necessary to explore a comparatively large area. The variation in grading was one of the factors influencing the contractor in using a portable screening plant which could be moved readily and so handle only those portions of the deposit which more nearly met the requirements. Aggregates were stock-piled near the deposit and hauled to bunkers at the mixing plant as needed since no storage space was available nearer to the job. Access to the aggregate deposit was provided first by a road cut into the steep canyon well and later by a road along a gravel bar in the river channel.

The total concrete placed was approximately 16,000 cubic yards. This quantity was in three main divisions as follows: 9,700 cubic yards in the spillway crest and gate structure, 3,000 cubic yards in spillway channel lining, and 3,300 cubic yards in a thrust block reinforcing the left abutment of the dam. A very simple central mixing plant was used consisting of bunkers, weighing hoppers, and a 1-cubic-yard electrically driven mixer, so arranged on the left wall of the channel that all material moved by gravity to a 1-cubic-yard bucket. Concrete was moved from here to the final point of placement by truck and derrick. Although some built-in-place forms were necessary, the structure as a whole was well adapted to the use of panel forms, which for the most part were made of heavy plywood.

Of special interest is the purpose of the so-called thrust block on the left abutment of the dam. Thorough analysis of the forces acting upon the dam disclosed the fact that, after excavation for the spillway channel, certain reactions due to rising temperature would cause undesirable stresses in the abutment. To carry these stresses, it was decided to place a large mass of concrete on the abutment and anchor the end of the dam to it.

The method of anchoring used was rather novel. Six vertical rows of holes were drilled through the dam as close to its end as possible, beginning at the new spillway crest elevation and reaching to the top. About 250 holes at approximately 15-inch centers were drilled. Thickness of the dam in this area was about 13 feet. Drilling was done with a wagon drill removed from its trucks, mounted on a bar and operated in the same manner as a Leynor Drill is used in a tunnel heading. The drilling was done from a hanging scaffold on the downstream face of the dam. All holes had a downward slope of 1:6 toward the upstream face.

Grout was pumped into the holes from the upstream end, after which 1¼-inch square bars, 36 feet 6 inches long, of high strength reinforcing steel, were inserted from the downstream end. A concrete vibrator was attached to each bar for a short period in order to assure intimate contact with the grout. The upstream ends of the anchors were covered with an 18-inch thick slab of concrete after a 6- by 6-inch steel plate had been welded to each one. These long anchors extend downstream into the massive thrust block and provide the necessary additional support to counteract the stresses which tend to push the end of the dam into the spillway channel.

Erection of the two 50- by 50-foot regulating gates and their operating machinery constituted another major division of the job, involving more than 1,500,000 pounds of metal work. The gates were assembled in the raised or open position, and because of the lack of clearance around the ends, it was necessary to complete their assembly before the concrete towers supporting the operating house were placed. This also made it possible to cast the concrete counterweights in their lowest position. The gates, as well as the operating machinery, were shop assembled and checked so there was very little difficulty in the way of misfits.

The hoists for each gate are powered with a 7½-horsepower direct-current motor. Current is supplied by an independent power plant consisting of gasoline-engine driven generators installed in a room provided for that purpose on the abutment near the thrust block. The installation of an independent power supply for gate operation is prompted by the fact that the Mormon Flat powerhouse may be out of commission during extremely high floods and that bad weather conditions prevailing at such a time may cause interruption of transmission lines. Lighting circuits, however, can be supplied from either the direct-current installation or from system power.

One of the most difficult phases of the job was to coordinate the association's water storage and power development program with the contractor's schedule of operation in such a way as to give each maximum benefit. In many cases, the plan adopted was of necessity a compromise of opposing views.

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DAVID B. HEMBY, 1867-1938

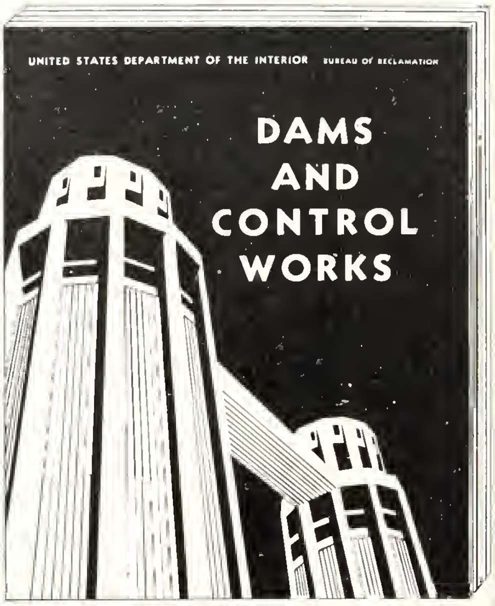
DAVID B. HEMBY, native of Morristown, Minn., died at his home in Mitchell, Nebr., on April 5, having been in poor health for the past 2 years.

For nearly 30 years Mr. Hemby had been water master over 38,000 acres of land in the Pathfinder Irrigation District, having held that position from the time the Reclamation Service began operations in western Nebraska until illness forced him to retire.

Mr. Hemby lived successively in Morristown, Minn.; Great Bend, Kans.; Denver, Colo.; Idaho Springs, Idaho; Fort Collins, Colo.; and Mitchell, Nebr. He is survived by his widow, Mrs. Emma Clark Hemby.

DAMS *and* CONTROL WORKS *Now Available*

A beautifully illustrated book Dams and Control Works is just off the press and copies may be obtained upon application to the Commissioner, Bureau of Reclamation, Depart-



ment of the Interior, Washington, D. C., at $1 per copy mailed to points within continental United States, with an additional cost of 32 cents to foreign countries, payment to be made by check or money order drawn to the Bureau of Reclamation.

This 261-page book, with 153 illustrations, contains articles descriptive of the design and construction of the storage and diversion dams, also articles on laboratory operations, model testing, and other special subjects.

Bridge Construction

THE city of Klamath Falls, Oreg., is constructing four new bridges over the Government main canal within the city limits, and Klamath County is constructing two new highway bridges over the same canal just outside the city limits.

Boulder City Air-Mail Service

ON APRIL 3 air-mail service was inaugurated for Boulder City, Nev., after the Department of Commerce gave a first class rating to the Boulder City airport for landing of the planes scheduled for Los Angeles and other coastal points. There was a rush of business at the Boulder City post office for first day covers and members of the staff in the Washington office were remembered in this connection.

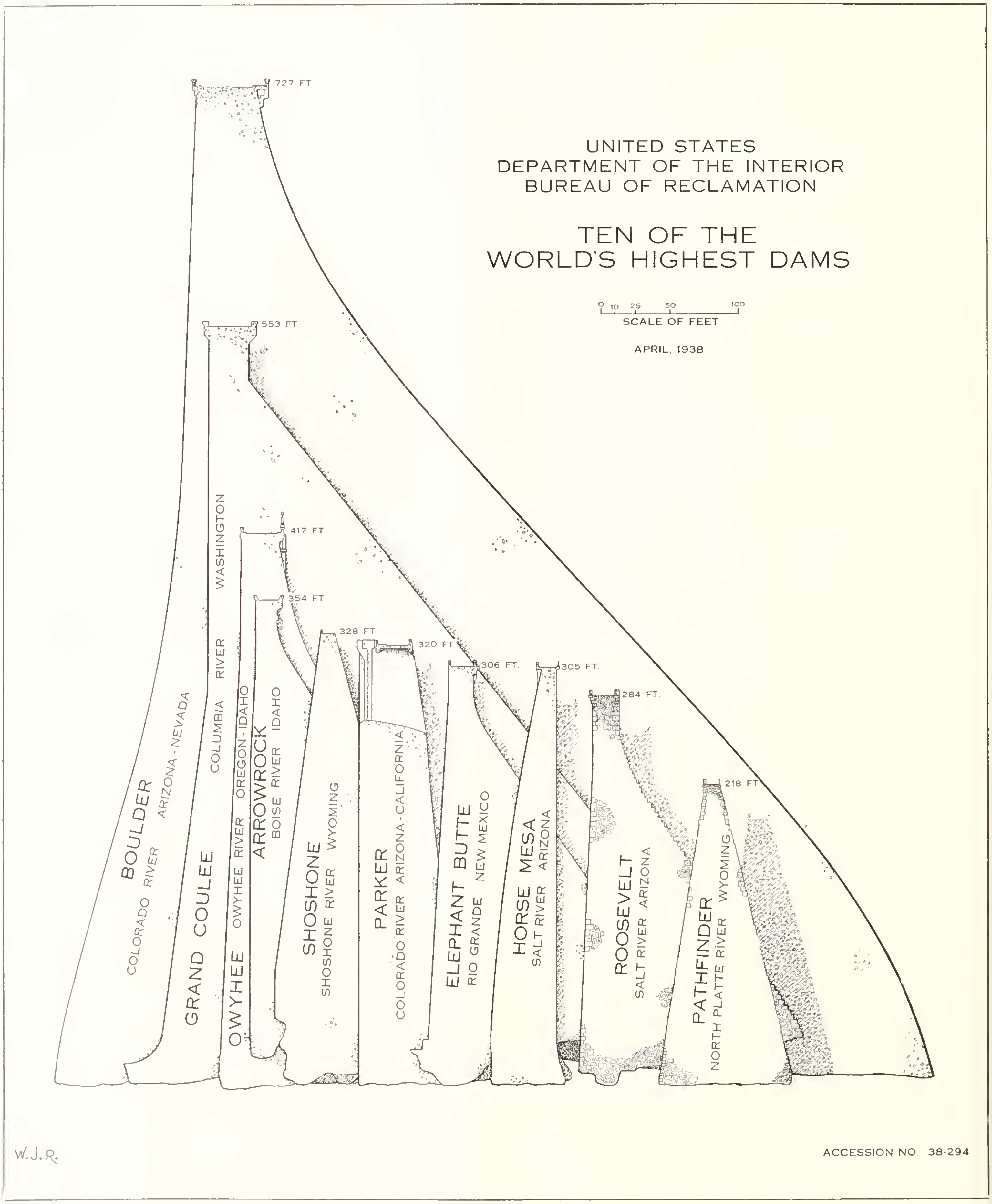
Dams on Federal Reclamation Projects

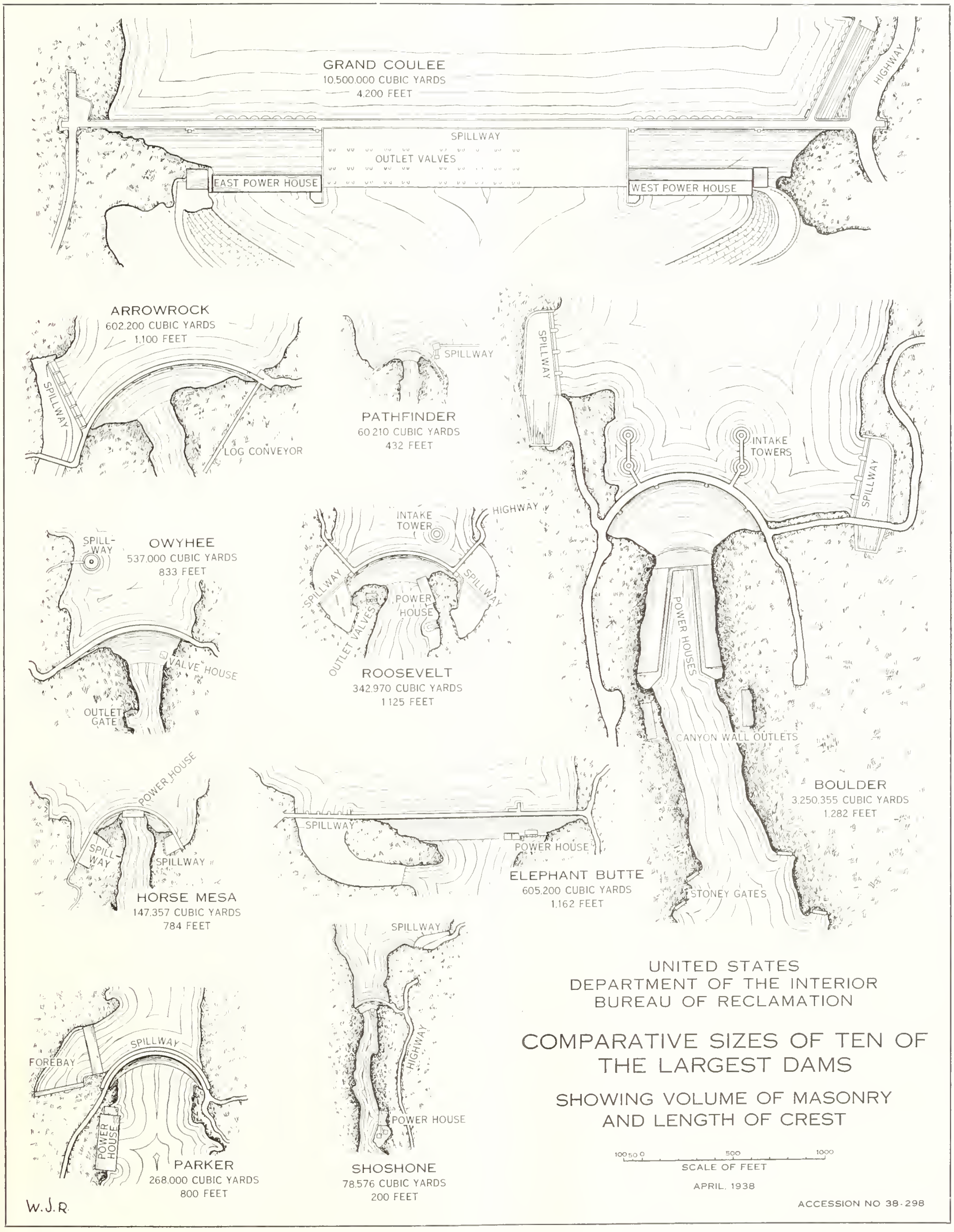
Maximum height (feet)	Name	State
727	Boulder	Arizona-Nevada
[1] 553	Grand Coulee	Washington
417	Owyhee	Oregon
354	Arrowrock	Idaho
328	Shoshone	Wyoming
[1] 322	Parker	Arizona-California
306	Elephant Butte	New Mexico
305	Horse Mesa	Arizona
284	Roosevelt	Do.
[1] 270	Bartlett	Do.
[1] 265	Seminoe	Wyoming
[1] 256	Alcova	Do.
229	Mormon Flat	Arizona
222	Tieton	Washington
218	Pathfinder	Wyoming
212	Stewart Mountain	Arizona
200	Taylor Park	Colorado
195	Gibson	Montana
[1] 190	Marshall Ford	Texas
183	Black Canyon	Idaho
165	McKay	Oregon
165	Deadwood	Idaho
151	Echo	Utah
[2] 150	Deer Creek	Utah
142	Alamogordo	New Mexico
142	Stony Gorge	California
139	East Park	Do.
135	Cle Elum	Washington
135	Sun River	Montana
[3] 125	Vallecito	Colorado
124	Lahontan	Nevada
122	Belle Fourche	South Dakota
[1] 120	Grassy Lake	Idaho
[1] 110	Boca	California
[1] 110	Moon Lake	Utah
109	Cave Creek	Arizona
109	Warm Springs	Oregon
105	Guernsey	Wyoming
100	Pineview	Utah
98	Cold Springs	Oregon
98	Sherburne Lakes	Montana
93	Agency Valley	Oregon
[1] 90	Caballo	New Mexico
90	Hyrum	Utah
[1] 89	Island Park	Idaho
88	Gerber	Oregon
87	American Falls	Idaho
86	Milner	Do.
86	Minidoka	Do.
84	Clear Creek	Washington
83	Unity	Oregon
[1] 77	Fresno	Montana
[1] 75	Bull Lake	Wyoming
75	Rye Patch	Nevada
72	Strawberry	Utah
71	Willow Creek	Montana
70	Keechelus	Washington
70	Thief Valley	Oregon
70	Upper Deer Flat	Idaho
70	Willwood	Wyoming
68	Boise River	Idaho
[1] 68	Midview	Utah
67	Conconully	Washington
67	Jackson Lake	Wyoming
66	Easton	Washington
65	Minatare	Nebraska
63	Kachess	Washington
57	McMillan	New Mexico
54	Avalon	Do.
50	Elephant Butte Dike	Do.
50	Ralston	Wyoming
45	Bumping Lake	Washington
[1] 45	Imperial	Arizona-California
44	East Park Feed	California
42	Anita	Montana
42	Pishkun Dike	Do.
40	Laguna	Arizona-California
40	Lost River	Oregon
40	Lower Deer Flat	Idaho
40	Pilot Butte No. 1	Wyoming
40	Salmon Lake	Washington
38	Indian Creek Dike	Utah
38	Pathfinder Dike	Wyoming
38	Granite Reef	Arizona
37	Wind River	Wyoming
35	Vandalia	Montana
35	Whalen	Wyoming
33	Clear Lake	California
32	Dodson	Montana
32	Malone	Oregon
30	Upper Lake Alice	Nebraska
30	Weber River	Utah
28	Nelson Dike	Montana
27	Derby Dam	Nevada
[1] 25	Arroyo	Wyoming
24	Colorado River-Roller Crest	Colorado
24	Pilot Butte No. 2	Oregon
24	Three Mile Falls	New Mexico
23	Lower Lake Alice	Nebraska
23	Belle Fourche Diversion	South Dakota
22	Link River	Oregon
21	Midview Dike	Utah
20	East Park Dike	California
20	Carson River	Nevada
20	South Canal	California
18	Corbett	Wyoming
18	Deaver	Do.
18	Frenchtown	Montana
18	Joint Head	Arizona
18	Swift Current	Montana
17	Cascade Creek	Idaho
17	Indian Creek Crossing	Utah
17	Percha	New Mexico
17	Spanish Fork	Utah
16	Deer Flat Forest	Idaho
16	Mesilla	New Mexico
15	Cross Cut	Idaho
15	Lower Lost River	Oregon
14	Harper	Oregon
14	Lake Tahoe	California
14	Maxwell	Oregon
14	Point of Rocks	Montana
13	Clear Lake Dike	California
13	Power Canal	Arizona
12	Pilot Butte No. 3	Wyoming
12	Lower Yellowstone	Montana
12	St. Mary	Do.
12	Miller	Oregon
10	Gunnison	Colorado
10	Leasburg	New Mexico
8	Echo Diversion	Oregon
8	Ironstone	Colorado
8	Loutsenhizer	Colorado
8	North Side-Orland	California
8	Prosser	Washington
8	Sunnyside	Do.
7	East Canal	Colorado
7	Montrose & Delta	Do.
6	Garnet	Do.
8	Horse Creek	Nebraska
6	Selig	Colorado
5	Mexican	Texas-Mexico
4	Salmon Creek	Washington
4	Tieton Diversion	Do.
4	Clear Lake Dike	California
3	East Park Dike	Do.

[1] Under construction.
[2] Contract awarded March 24, 1938.
[3] Contract awarded February 17, 1938.

TEN OF THE HIGHEST DAMS ON THE FEDERAL RECLAMATION PROJECTS

Name	River	State	Maximum height	Crest length	Volume	Type	Year completed	Cost
			Feet	*Feet*	*Cubic yards*			
Boulder	Colorado	Arizona-Nevada	727	1, 282	3, 250, 335	Concrete, arch-gravity	1936	$70, 600, 000
Grand Coulee	Columbia	Washington	553	4, 200	10, 500, 000	Concrete, straight gravity	1942	118, 600, 000
Owyhee	Owyhee	Oregon	417	833	536, 471	Concrete, arch-gravity	1932	5, 672, 000
Arrowrock	Boise	Idaho	354	1, 100	602, 200	Rubble concrete, arch-gravity	1915	4, 928, 000
Shoshone	Shoshone	Wyoming	328	200	78, 576	Rubble concrete arch	1910	1, 439, 000
Parker	Colorado	Arizona-California	322	800	268, 000	Concrete, variable radius arch	1938	8, 805, 000
Elephant Butte	Rio Grande	New Mexico	306	1, 162	605, 200	Cyclopean rubble concrete, gravity	1916	4, 538, 000
Horse Mesa	Salt River	Arizona	305	784	147, 357	Concrete, variable radius arch	1927	2, 873, 000
Roosevelt	do.	do.	284	1, 125	342, 970	Rubble masonry, arch-gravity	1911	3, 806, 000
Pathfinder	North Platte	Wyoming	218	432	60, 210	Granite masonry, arch-gravity	1909	1, 755, 000


UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
TEN OF THE
WORLD'S HIGHEST DAMS
0 10 25 50 100
SCALE OF FEET
APRIL, 1938
727 FT
553 FT
417 FT
354 FT
328 FT
320 FT
306 FT.
305 FT.
284 FT.
218 FT
BOULDER
COLORADO RIVER
ARIZONA-NEVADA
GRAND COULEE
COLUMBIA RIVER
WASHINGTON
OWYHEE
OWYHEE RIVER
OREGON-IDAHO
ARROWROCK
BOISE RIVER
IDAHO
SHOSHONE
SHOSHONE RIVER
WYOMING
PARKER
COLORADO RIVER
ARIZONA-CALIFORNIA
ELEPHANT BUTTE
RIO GRANDE
NEW MEXICO
HORSE MESA
SALT RIVER
ARIZONA
ROOSEVELT
SALT RIVER
ARIZONA
PATHFINDER
NORTH PLATTE RIVER
WYOMING
W.J.R.
ACCESSION NO. 38-294


GRAND COULEE
10,500,000 CUBIC YARDS
4,200 FEET
HIGHWAY
SPILLWAY
OUTLET VALVES
EAST POWER HOUSE
WEST POWER HOUSE
ARROWROCK
602,200 CUBIC YARDS
1,100 FEET
SPILLWAY
LOG CONVEYOR
SPILLWAY
PATHFINDER
60,210 CUBIC YARDS
432 FEET
SPILLWAY
INTAKE TOWERS
SPILLWAY
POWER HOUSES
CANYON WALL OUTLETS
BOULDER
3,250,355 CUBIC YARDS
1,282 FEET
STONEY GATES
SPILL-WAY
OWYHEE
537,000 CUBIC YARDS
833 FEET
VALVE HOUSE
OUTLET GATE
INTAKE TOWER
HIGHWAY
SPILLWAY
SPILLWAY
POWER HOUSE
OUTLET VALVES
ROOSEVELT
342,970 CUBIC YARDS
1,125 FEET
POWER HOUSE
SPILL-WAY
SPILLWAY
HORSE MESA
147,357 CUBIC YARDS
784 FEET
SPILLWAY
POWER HOUSE
ELEPHANT BUTTE
605,200 CUBIC YARDS
1,162 FEET
SPILLWAY
HIGHWAY
POWER HOUSE
SHOSHONE
78,576 CUBIC YARDS
200 FEET
FOREBAY
SPILLWAY
POWER HOUSE
PARKER
268,000 CUBIC YARDS
800 FEET
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COMPARATIVE SIZES OF TEN OF THE LARGEST DAMS
SHOWING VOLUME OF MASONRY AND LENGTH OF CREST
100 50 0 500 1000
SCALE OF FEET
APRIL, 1938
ACCESSION NO 38-298
W. J. R.

Reclamation Organization Activities

Commissioner Page in the West

JOHN C. PAGE, Commissioner of Reclamation, left Washington for the West on March 31. His first stop was at Omaha, Nebr., where on April 2 he addressed the Nebraska Engineering Society on the subject The Engineer Plus, which appears in this issue. At Denver Mr. Page conferred with the Chief Engineer's staff on matters pending on a number of the projects, and in California he visited the Central Valley project, returning to Washington on April 20.

Commissioner Page addressed the Boston Society of Civil Engineers on April 27, on the subject of The Story of Reclamation.

Denver Officials in Washington

CHIEF Engineer Walter, Chief Designing Engineer Savage, and Chief Electrical Engineer McClellan, all from the Denver office, came to Washington the first week of May to plan the organization and method of handling the construction program to be undertaken this year.

Appointments

THE following personnel changes in the Bureau of Reclamation have been authorized by the Secretary of the Interior:

Denver Office:

Leo Krisl, junior engineer, vice Fred E. Cornwell, reassigned.

James L. Twombly, junior engineer, from inspector (dredging), War Department, vice Casper F. Hegner.

Francis E. Swain, junior engineer.

Central Valley:

Carl H. Holley, associate engineer.

Walter E. Seyfarth, associate engineer (Friant Division).

Boulder Canyon:

Norman J. Mittenthal, associate engineer.

Transfers

To Truckee Storage:

John J. Welsh and John S. Smith, assistant engineers, from All-American Canal, Yuma, Ariz.

John C. Diehl, associate engineer, from Yuma, Ariz., to associate engineer, Reno, Nev.

To Fruit Growers Dam:

Clyde H. Spencer, construction engineer, from Denver, Colo.

R. C. E. Weber Retires

R. C. E. WEBER, superintendent of the Yuma project for the past 4 years, resigned from the service of the Reclamation Bureau, effective March 31, 1938.

Mr. Weber entered the employ of the Bureau as junior engineer May 6, 1909, and during the summer of that year was engaged on Sacramento Valley investigations. In October 1909, he was transferred to the Orland project in California, where he was continuously employed except for a period of about 1 month in the fall of 1913 when he was with the California Railroad Commission. On February 1, 1913, he was appointed assistant

engineer of the Orland project, and was promoted to the position of engineer on the same project July 1, 1920. His appointment as superintendent of the Orland project became effective December 16, 1922, although he was assigned the duties of the position on July 1, 1921. On March 15, 1934, he was transferred to the Yuma project where he served as superintendent until the time of his resignation.

During his almost 30 years of service with the Reclamation Bureau, Mr. Weber proved himself to be a valued employee, well fitted by reason of his wide experience and real interest in irrigation methods and their development of the West, for the positions he held.

Mr. Weber intends to spend part of his time traveling and also devote considerable time to his parents whose home is in Laurel, Ind. His immediate plans include a month's trip to the Pacific coast and the Orland project, after which he expects to return East in time to attend the annual class reunions at Purdue University, where he graduated in civil engineering in 1907.

On leaving the Government service Mr. Weber was presented with a hand-carved leather briefcase by employees of the Yuma project. Members of the Yuma County Water Users' Association presented Mr. Weber with a set of traveling bags consisting of a large suitcase and a smaller traveling bag, the latter of which contained a monogrammed fitted case.

Charles B. Elliott, construction engineer at Montrose, Colo., has been transferred to Yuma to succeed Mr. Weber as superintendent of the Yuma project.

Separations

Denver Office:

James Alan McLennan, engineer, to accept employment with the Babcock & Wilcox Co. in New York.

Colorado River:

William S. Argo, assistant engineer, work to which assigned having been completed.

Salt River:

Carl L. Meng, assistant engineer, due to completion of work.

P. T. Sutphen Dies

WORD has been received from the Minidoka project of the death on February 26, after a 2 weeks' illness, of P. T. Sutphen in Gooding, Idaho. Mr. Sutphen had for some years been the efficient secretary-treasurer of the American Falls Reservoir District No. 2. Miss Ida M. Johnson, of Gooding, has been appointed to succeed Mr. Sutphen.

Power Lines From Boulder Dam

The electric power transmission lines extending from the Boulder Dam power plant are as follows:

Name	Voltage	Frequency	Remarks
	Kilovolts	*Cycles*	
City of Los Angeles	287	60	2 lines.
Metropolitan Water District.	230	60	
Southern California Edison Co.	230	50	
Nevada-California Electric Corporation.	138	60	
Lincoln County Power Dist. No. 1.	69	60	Constructed for 138 kilovolts.
Needles Gas & Electric Co.	69	60	
Southern Nevada Power Co.	53	63	
Boulder City	33	60	
Citizens Utilities Co.	69	60	

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ADMINISTRATIVE ORGANIZATION OF THE BUREAU OF RECLAMATION

HAROLD L. ICKES, SECRETARY OF THE INTERIOR

E. K. BURLEW, FIRST ASSISTANT SECRETARY and Budget Officer (in charge of reclamation)

John C. Page, Commissioner — Roy B. Williams, Assistant Commissioner

J. Kennard Cheadle, Chief Counsel and Assistant to Commissioner, Miss Mae A. Schnurr, Chief of Public Relations; George O. Sanford, General Supervisor of Operation and Maintenance; D. S. Stuver, Asst. Gen. Supr.; Wesley R. Nelson, Chief, Engineering Division; P. I. Taylor, Assistant Chief; A. R. Golzé, Supervising Engineer, C. C. C. Division; William F. Kubach, Chief Accountant; Charles N. McCulloch, Chief Clerk; Jesse W. Myer, Chief, Mails and Files Division; Miss Mary E. Gallagher, Secretary to the Commissioner

Denver, Colo., United States Customhouse

R. F. Walter, Chief Eng.; S. O. Harper, Asst. Chief Eng.; J. L. Savage, Chief Designing Eng.; W. H. Nalder, Asst. Chief Designing Eng.; L. N. McClellan, Chief Electrical Eng.; Kenneth B. Keener, Senior Engineer, Dams; H. R. McBirney, Senior Engineer, Canals; E. B. Debler, Hydraulic Eng.; I. E. Houk, Senior Engineer, Technical Studies; Spencer L. Baird, District Counsel; L. R. Smith, Chief Clerk; Harry Caden, Fiscal Agent; Vern H. Thompson, Purchasing Agent; C. A. Lyman and Henry W. Johnson, Field Representatives; L. S. Davis, Engineer, C. C. C. Division

Projects under construction or operated in whole or in part by the Bureau of Reclamation

Project	Office	Official in charge		Chief clerk	District counsel	
		Name	Title		Name	Address
All-American Canal [1]	Yuma, Ariz.	Leo J. Foster	Constr. engr.	J. C. Thrailkill	R. J. Coffey	Los Angeles, Calif.
Belle Fourche	Newell, S. Dak.	F. C. Youngblutt	Superintendent	J. P. Siebeneicher	W. J. Burke	Billings, Mont.
Boise	Boise, Idaho	R. J. Newell	Constr. engr.	Robert B. Smith	B. E. Stoutemyer	Portland, Oreg.
Boulder Dam and power plant [1]	Boulder City, Nev.	Irving C. Harris	Acting Constr. engr.	Gail H. Baird	R. J. Coffey	Los Angeles, Calif.
Buffalo Rapids	Glendive, Mont.	Paul A. Jones	Constr. engr.	Edwin M. Bean	W. J. Burke	Billings, Mont.
Carlsbad	Carlsbad, N. Mex.	L. E. Foster	Superintendent	E. W. Shepard	H. J. S. Devries	El Paso, Tex.
Central Valley	Sacramento, Calif.	W. R. Young	Constr. engr.	E. R. Mills	R. J. Coffey	Los Angeles, Calif.
Shasta Dam	Redding, Calif.	Ralph Lowry	Constr. engr.		R. J. Coffey	Los Angeles, Calif.
Colorado-Big Thompson	Denver, Colo.				J. R. Alexander	Salt Lake City, Utah
Colorado River	Austin, Tex.	Ernest A. Moritz	Constr. engr.	William F. Sha	H. J. S. Devries	El Paso, Tex.
Columbia Basin	Coulee Dam, Wash.	F. A. Banks	Constr. engr.	C. B. Funk	B. E. Stoutemyer	Portland, Oreg.
Fruit Grower's Dam	Montrose, Colo.	Clyde H. Spencer	Constr. engr.	Ewalt P. Anderson	J. R. Alexander	Salt Lake City, Utah
Gila	Yuma, Ariz.	Leo J. Foster	Constr. engr.		R. J. Coffey	Los Angeles, Calif.
Grand Valley	Grand Junction, Colo.	W. J. Chiesman	Superintendent	Emil T. Ficenec	J. R. Alexander	Salt Lake City, Utah.
Humboldt	Lovelock, Nev.	Stanley R. Marean	Resident engr.[2]	George B. Snow	J. R. Alexander	Salt Lake City, Utah.
Kendrick	Casper, Wyo.	H. W. Bashore	Constr. engr.	C. M. Voyen	W. J. Burke	Billings, Mont.
Klamath	Klamath Falls, Oreg.	B. E. Hayden	Superintendent	W. I. Tingley	B. E. Stoutemyer	Portland, Oreg.
Milk River	Malta, Mont.	H. H. Johnson	Superintendent	E. E. Chabot	W. J. Burke	Billings, Mont.
Fresno Dam	Havre, Mont.	H. V. Hubbell	Constr. engr.	E. E. Chabot	W. J. Burke	Billings, Mont.
Minidoka	Burley, Idaho	Dana Templin	Superintendent	G. C. Patterson	B. E. Stoutemyer	Portland, Oreg.
Moon Lake	Duchesne, Utah	E. J. Westerhouse	Constr. engr.	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
North Platte	Guernsey, Wyo.	C. F. Gleason	Supt. of power	A. T. Stimpfig	W. J. Burke	Billings, Mont.
Orland	Orland, Calif.	D. L. Carmody	Superintendent	W. D. Funk	R. J. Coffey	Los Angeles, Calif.
Owyhee	Boise, Idaho	R. J. Newell	Constr. engr.	Robert B. Smith	B. E. Stoutemyer	Portland, Oreg.
Parker Dam	Parker Dam, Calif.	Howard P. Bunger	Constr. engr.	George W. Lyle	R. J. Coffey	Los Angeles, Calif.
Pine River	Bayfield, Colo.	Charles A. Burns	Constr. engr.	John S. Martin	J. R. Alexander	Salt Lake City, Utah.
Provo River	Provo, Utah	E. O. Larson	Engineer	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
Rio Grande	El Paso, Tex.	L. R. Fiock	Superintendent	H. H. Berryhill	H. J. S. Devries	El Paso, Tex.
Caballo Dam	Caballo, N. Mex.	S. F. Creecelius	Constr. engr.	H. H. Berryhill	H. J. S. Devries	El Paso, Tex.
Riverton	Riverton, Wyo.	H. D. Comstock	Superintendent	C. B. Wentzel	W. J. Burke	Billings, Mont.
Bull Lake Dam	Riverton, Wyo.	Arthur P. Smyth	Resident engr.	Chas. B. Wentzel	W. J. Burke	Billings, Mont.
Salt River	Phoenix, Ariz.	E. C. Koppen	Constr. engr.	Edgar A. Peek	R. J. Coffey	Los Angeles, Calif.
Sanpete	Provo, Utah	E. O. Larson	Engineer	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
Shoshone	Powell, Wyo.	L. J. Windle	Superintendent [2]	L. J. Windle [2]	W. J. Burke	Billings, Mont.
Heart Mountain division	Cody, Wyo.	Walter F. Kemp	Constr. engr.	L. J. Windle [2]	W. J. Burke	Billings, Mont.
Sun River, Greenfields division	Fairfield, Mont.	A. W. Walker	Superintendent		W. J. Burke	Billings, Mont.
Truckee River Storage	Reno, Nev.	Charles S. Hale	Constr. engr.	George B. Snow	J. R. Alexander	Salt Lake City, Utah.
Umatilla (McKay Dam)	Pendleton, Oreg.	C. L. Tice	Reservoir supt.		B. E. Stoutemyer	Portland, Oreg.
Uncompahgre: Repairs to canals	Montrose, Colo.				J. R. Alexander	Salt Lake City, Utah.
Upper Snake River Storage [3]	Ashton, Idaho	H. A. Parker	Constr. engr.	Emmanuel V. Hillius	B. E. Stoutemyer	Portland, Oreg.
Vale	Vale, Oreg.	C. C. Ketchum	Superintendent		B. E. Stoutemyer	Portland, Oreg.
Yakima	Yakima, Wash.	J. S. Moore	Superintendent	Philo M. Wheeler	B. E. Stoutemyer	Portland, Oreg.
Roza division	Yakima, Wash.	Charles E. Crownover	Constr. engr.	Alex S. Harker	B. E. Stoutemyer	Portland, Oreg.
Yuma	Yuma, Ariz.	C. B. Elliott	Superintendent	Noble O. Anderson	R. J. Coffey	Los Angeles, Calif.

[1] Boulder Canyon. [2] Acting. [3] Island Park and Grassy Lake Dams.

Projects or divisions of projects of Bureau of Reclamation operated by water users

Project	Organization	Office	Operating official		Secretary	
			Name	Title	Name	Address
Baker (Thief Valley division) [1]	Lower Powder River irrigation district	Baker, Oreg.	A. J. Ritter	President	F. A. Phillips	Keating
Bitter Root [4]	Bitter Root irrigation district	Hamilton, Mont.	N. W. Blindauer	Manager	Elsie H. Wagner	Hamilton.
Boise [1]	Board of Control	Boise, Idaho	Wm. H. Tuller	Project manager	L. P. Jensen	Boise.
Boise [1]	Black Canyon irrigation district	Notus, Idaho	W. H. Jordan	Superintendent	L. M. Watson	Caldwell.
Frenchtown	Frenchtown irrigation district	Frenchtown, Mont.			Ralph P. Scheffer	Huson
Grand Valley, Orchard Mesa [3]	Orchard Mesa irrigation district	Grand Jctn., Colo.	C. W. Tharp	Superintendent	C. J. McCormich	Grand Jctn.
Huntley [4]	Huntley irrigation district	Ballantine, Mont.	E. E. Lewis	Manager	H. S. Elliott	Ballantine.
Hyrum [3]	South Cache W. U. A.	Hyrum, Utah	B. L. Mendenhall	Superintendent	Harry C. Parker	Logan
Klamath, Langell Valley [1]	Langell Valley irrigation district	Bonanza, Oreg.	Chas. A. Revell	Manager	Chas. A. Revell	Bonanza.
Klamath, Horsefly [1]	Horsefly irrigation district	Bonanza, Oreg.	Henry Schmor, Jr.	President	Dorothy Eyers	Bonanza
Lower Yellowstone [4]	Board of Control	Sidney, Mont.	Axel Persson	Manager	Axel Persson	Sidney.
Milk River: Chinook division [4]	Alfalfa Valley irrigation district	Chinook, Mont.	A. L. Benton	President	R. H. Clarkson	Chinook.
Minidoka: Gravity [1]	Minidoka irrigation district	Rupert, Idaho	Frank A. Ballard	Manager	O. W. Paul	Rupert.
Pumping [1]	Burley irrigation district	Burley, Idaho	Hugh L. Crawford	Manager	Frank O. Redfield	Burley.
Gooding [1]	Amer. Falls Reserv. Dist. No. 2	Gooding, Idaho	S. T. Baer	Manager	Ida M. Johnson	Gooding.
Newlands [3]	Truckee-Carson irrigation district	Fallon, Nev.	W. H. Wallace	Manager	H. W. Emery	Fallon.
North Platte: Interstate division [4]	Pathfinder irrigation district	Mitchell, Nebr.	T. W. Parry	Manager	Flora K. Schroeder	Mitchell.
Fort Laramie division [4]	Gering-Fort Laramie irrigation district	Gering, Nebr.	W. O. Fleenor	Superintendent	C. G. Klingman	Gering.
Fort Laramie division [4]	Goshen irrigation district	Torrington, Wyo.	Bert L. Adams	Superintendent	Mary E. Harrach	Torrington
Northport division [4]	Northport irrigation district	Northport, Nebr.	Mark Iddings	Superintendent	Mabel J. Thompson	Bridgeport
Okanogan [1]	Okanogan irrigation district	Okanogan, Wash.	Nelson D. Thorp	Manager	Nelson D. Thorp	Okanogan
Salt Lake Basin (Echo Res.) [3]	Weber River Water Users' Assn.	Ogden, Utah	D. D. Harris	Manager	D. D. Harris	Layton
Salt River [2]	Salt River Valley W. U. A.	Phoenix, Ariz.	H. J. Lawson	Superintendent	F. C. Henshaw	Phoenix
Shoshone: Garland division [4]	Shoshone irrigation district	Powell, Wyo.	M. P. McLaughlin	Irri. superintendent	Geo. W. Atkins	Powell
Frannie division [4]	Deaver irrigation district	Deaver, Wyo.	Floyd Lucas	Superintendent	Lee N. Richards	Deaver
Strawberry Valley [3]	Strawberry Water Users' Assn.	Payson, Utah	S. W. Grotegut	Manager	E. G. Breeze	Payson
Sun River: Fort Shaw division [4]	Fort Shaw irrigation district	Fort Shaw, Mont.	C. L. Bailey	Manager	E. J. Gregory	Fort Shaw
Greenfields division [4]	Greenfields irrigation district	Fairfield, Mont.	A. W. Walker	Manager	H. P. Wangen	Fairfield
Umatilla: East division [1]	Hermiston irrigation district	Hermiston, Oreg.	E. D. Martin	Manager	Enos D. Martin	Hermiston
West division [1]	West Extension irrigation district	Irrigon, Oreg.	A. C. Houghton	Manager	A. C. Houghton	Irrigon
Uncompahgre [3]	Uncompahgre Valley W. U. A.	Montrose, Colo.	Jesse R. Thompson	Acting superintendent	J. Frank Anderson	Montrose
Yakima, Kittitas division [1]	Kittitas reclamation district	Ellensburg, Wash.	V. W. Russell	Manager	G. L. Sterling	Ellensburg

[1] B. E. Stoutemyer, district counsel, Portland, Oreg.
[2] R. J. Coffey, district counsel, Los Angeles, Calif.
[3] J. R. Alexander, district counsel, Salt Lake City, Utah.
[4] W. J. Burke, district counsel, Billings, Mont.

Important investigations in progress

Project	Office	In charge of—	Title
Colorado River Basin, sec. 15	Denver, Colo.	P. J. Preston	Senior engineer.
Boise-Weiser-Payette	Boise, Idaho	Lester C. Walker	Engineer.
Cabinet Gorge	Clarks Fork, Idaho	Wm. G. Sloan	Engineer.
Kings River-Pine Flat	Fresno, Calif.	John R. Iakisch	Constr. engineer.
Western Slope (Colo.)	Denver, Colo.	Frank C. Merriell	Engineer.
Black Hills	Denver, Colo.	R. E. Kennedy	Assistant engineer.
Eastern Slope (Colo.)	Denver, Colo.	A. N. Thompson	Engineer.
Salt Lake Basin	Salt Lake City, Utah	E. O. Larson	Engineer.
Deschutes	Bend, Oreg.	C. C. Fisher	Engineer
Marias	Shelby, Mont.	Fred H. Nichols	Associate engineer
Green River-Bear River	Denver, Colo.		

Issued monthly by the Bureau of Reclamation, Department of the Interior, as approved by the Director of the Budget. SALLIE A. B. COE, *Editor*.

KETTLE FALLS ON UPPER COLUMBIA RIVER

THE RECLAMATION ERA

JUNE 1938

SUGAR BEETS, NONCOMPETITIVE CROP, THRIVE UNDER IRRIGATION

HARRY SLATTERY

UNDER SECRETARY OF THE INTERIOR

HARRY SLATTERY, of Greenville, S. C., was on June 1 confirmed by the Senate as Under Secretary of the Interior on the nomination of President Roosevelt.

The choice of Mr. Slattery is a particularly happy one as he is well versed in the activities of the Department of the Interior. Mr. Slattery started his conservation career with the National Conservation Commission and later became a practicing attorney in Washington.

In 1918, during the Woodrow Wilson administration, Mr. Slattery was appointed as Special Assistant to the Secretary of the Interior, Franklin K. Lane, and dealt exclusively with land-reclamation projects. Leaving the service, he served as counsel for the National Boulder Dam Association and the National Conservation Committee. He was also the Washington representative of the Power Authority of the State of New York.

Called back to public service by Secretary Ickes in 1933, Mr. Slattery has served since in the dual capacity of Personal Assistant to the Secretary of the Interior and Personal Assistant to the Administrator of Public Works.

Commenting on the nomination, Secretary Ickes said:

"Mr. Slattery's record establishes him beyond challenge as worthy of the post for which he has been selected.

"For over 5 years he has served the Government and the Department in an efficient and loyal fashion which has won my respect and confidence.

"In the Department, we know him so well and he knows us so well that this nomination is, in effect, a merited promotion of a member of the staff."

Mr. Slattery was educated at Mount St. Mary's College in Maryland, Georgetown University, and George Washington University, and is a member of the bar.

The new Under Secretary has a tremendous capacity for hard work. He has an outstanding pleasing personality and wins friends as he goes. It has been said of him that he does all the good he can and never knows anything about it. He has a well-developed political sense and often is called on in an advisory capacity in the drafting of legislation. He assisted the late Senators Walsh and La Follette in the preliminary work which instituted the Teapot Dome and Naval Oil Reserve inquiry.

In 1932 Mr. Slattery's friends gave a public dinner in his honor at the Cosmos Club in Washington. Many beautiful tributes were paid to him by national leaders, and the telegrams and letters received numbered into the hundreds from all sections of the country. The affection expressed at that time by those paying him tribute has only increased with the years and he has added many more admirers to his list of friends through his service.

Mr. Slattery fills the position made vacant by the resignation of Charles West.

PRICE ONE DOLLAR A YEAR

THE RECLAMATION ERA

VOLUME 28 • JUNE 1938 • NUMBER 6

Appropriations for the Fiscal Year 1939

By WILLIAM F. KUBACH, *Chief Accountant, Bureau of Reclamation*

THE Interior Department Appropriation Act, containing appropriations for the Bureau of Reclamation for the fiscal year 1939 and important legislation designed to increase the reclamation fund, was signed by the President on May 9, 1938 (Public, No. 497, 75th Cong., 3d Sess.).

Important features of the act are outlined below.

The most important legislative item included in the act, and one of the most important pieces of legislation affecting reclamation in many years, is found in two paragraphs designed to increase the reclamation fund.

One of these makes available to the reclamation fund approximately $29,000,000 collected as royalties on oil from the naval reserves, of which $15,000,000 will be used to cancel a loan from the General Treasury to the reclamation fund. The remainder will be available for future appropriations from the reclamation fund.

The other part of this legislation directs that money received in repayment of the cost of construction of projects financed by allotment from Public Works and Emergency Relief funds, and by appropriations direct from the Treasury, with certain exceptions, shall be covered into the reclamation fund.

The language of these two paragraphs is as follows:

"Increase in the reclamation fund: The Secretary of the Treasury is authorized and directed to transfer to the credit of the reclamation fund, created by the act of June 17, 1902 (32 Stat. 388), a sum equal to the difference between (1) 52½ percentum of the moneys which the Secretary of the Treasury shall determine to have accrued to the United States from lands within the naval petroleum reserves, except those in Alaska, from February 25, 1920, to June 30, 1938, inclusive, and (2) the total of all sums advanced to the reclamation fund under the provisions of the act entitled 'An act to authorize advances to the reclamation fund, and for the issue and disposal of certificates of indebtedness in reimbursement therefor, and for other purposes,' approved June 25, 1910 (36 Stat. 835), as amended, and under the provisions of the act entitled 'An act to authorize advances to the reclamation fund, and for other purposes,' approved March 3, 1931 (46 Stat. 1507), as amended, and not reimbursed by transfer from the reclamation fund to the general funds in the Treasury. The transaction provided for in this section shall be deemed to have effected a complete reimbursement to the general funds in the Treasury of all sums advanced to the reclamation fund under the provisions of such acts of June 25, 1910, and March 3, 1931, as amended.

"All moneys received by the United States in connection with any irrigation projects, including the incidental power features thereof, constructed by the Secretary of the Interior through the Bureau of Reclamation and financed in whole or in part with moneys heretofore or hereafter appropriated or allocated therefor by the Federal Government, shall be covered into the reclamation fund, except in cases where provision has been made by law or contract for the use of such revenues for the benefit of users of water from such project: *Provided*, That after the net revenues derived from the sale of power developed in connection with any of said projects shall have repaid those construction costs of such project allocated to power to be repaid by power revenues therefrom and shall no longer be required to meet the contractual obligations of the United States, then said net revenues derived from the sale of power developed in connection with such project shall, after the close of each fiscal year, be transferred to and covered into the General Treasury as 'miscellaneous receipts': *Provided further*, That nothing in this section shall be construed to amend the Boulder Canyon Project Act (45 Stat. 1057), as amended, or to apply to irrigation projects of the Office of Indian Affairs."

Another important feature of the act was a provision for cooperative investigations, including investigations in the "dust bowl" area, in which the Bureau will cooperate with the Corps of Engineers, the Farm Security Administration, and other Federal agencies in the study and design of projects for irrigation, flood control, and resettlement. This item in the bill carried a directory provision that $25,000 of the $200,000 appropriated should be available for such a study of the proposed Altus project in Oklahoma.

Appropriations for reclamation projects from the General Fund were as follows:

Appropriations From General Fund

Boulder Canyon project.—Installation of additional generating units in the Boulder Dam power plant is provided for by the appropriation of $3,500,000. Delivery of firm energy from the plant was commenced on June 1, 1937. Revenues from the sale of energy and the payments for lease of machinery during the fiscal year 1938 will approximate $2,500,000. The revenue derived from this plant during the fiscal year 1939 will be approximately $4,000,000.

All-American Canal.—Continuation of construction of this canal and the branch main canal to Coachella is provided for by the appropriation of $500,000.

Continuation of the construction of the Central Valley project in California and the Grand Coulee Dam project in Washington is provided for by appropriations of $9,000,000 and $13,000,000, respectively.

The act provided that $250,000 of the $13,000,000 appropriated for the Grand Coulee Dam could be used in continuation of the surveys now in progress in the irrigable area of the project.

Appropriations from the reclamation fund were made both for operation and maintenance and for construction.

The act appropriates $814,600 for the operation and maintenance of regular reclamation fund projects. This is the smallest direct appropriation made for this purpose in many years, and reflects the fact that in 1926 a policy was adopted requiring the payment of operation and maintenance costs in advance. A large number of the projects operated and maintained by the Bureau now advance sufficient funds to finance this work. The Rio Grande project in New Mexico and Texas was the latest project to adopt this plan of payment for operation and maintenance. Among the older projects, only a

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few—the reservation division of the Yuma project in California, and the Sunnyside and Tieton divisions of the Yakima project in Washington—now wait until the close of the calendar year to pay for operation and maintenance services rendered.

Funds advanced to the Bureau for operation and maintenance by the projects total approximately $900,000 annually. Prior to the adoption of the advance payment plan, approximately $1,500,000 to $2,000,000 of the reclamation fund was tied up annually in financing operation and maintenance charges until collections were made.

The act also appropriates power revenues aggregating $360,000 for operation and maintenance of the several power plants on the projects.

Appropriations from the reclamation fund for continuation of construction on the projects amount to $9,760,000 as follows:

Gila project, Arizona, $900,000.

Salt River project, Arizona, $200,000.

Colorado-Big Thompson project, Colorado, $1,250,000.

Boise project, Idaho, Payette division, $500,000.

Twin Springs Dam and Snake River pumping plant, $750,000.

Minidoka project, Idaho, $400,000.

Upper Snake River storage project, Idaho, $250,000.

Sun River project, Montana, $300,000.

Carlsbad project, New Mexico, $100,000.

Rio Grande project, New Mexico-Texas, $500,000.

Deschutes project, Oregon, $300,000.

Owyhee project, Oregon, $310,000.

Ogden River project, Utah, $100,000.

Provo River project, Utah, $350,000.

Yakima project, Washington, Roza division, $1,000,000.

Kendrick project, Wyoming, $1,000,000.

Riverton project, Wyoming, $100,000.

Shoshone project, Wyoming, Heart Mountain division, $700,000.

Administrative expenses, $750,000.

One new project was included in the bill—the Twin Springs Dam. An appropriation of $2,030,000 also was made from the General Treasury on a nonreimbursable basis for continuation of the work on the Marshall Ford Dam, previously financed by allotment. This is the flood control unit of the Colorado River, Texas, project.

The act contained $750,000 for administrative expense in connection with projects to be constructed with money appropriated from the reclamation fund, and a similar sum for the same purpose in connection with the projects to be constructed with money appropriated from the general treasury.

Other legislative provisions in the act of some importance included:

Authorization to furnish water for the use of the Arizona State Experiment Farm to be established on the Gila project for the purpose of designing farming programs suitable to that area.

A provision in the appropriation for the Colorado-Big Thompson project that not less than $600,000 of the sum made available should be expended in the construction of the Green Mountain Reservoir, and that this reservoir should be started at or before the time construction was begun on the Continental Divide tunnel.

A provision that not to exceed $30,000 of the unexpended funds remaining from last year's appropriation for the Belle Fourche project should be available for providing ways and means of increasing the water supply for project lands under the Johnson lateral.

Provisions making it possible to condemn rights-of-way needed for relocation of highways, roadways, railroads, telegraph, telephone, or electric transmission lines, in connection with the Central Valley project, and to convey these rights-of-way in exchange in whole or in part for property within the dam and reservoir sites.

Farm Security Administration Active on Sun River Project

AT THE END of April the following report was made by Albert L. Johnson, community manager, regarding the progress made on the Sun River project, Montana, by the Farm Security Administration:

"One hundred and three tracts have been purchased which comprise 12,549 acres. These tracts were purchased, in most instances, from nonresident owners, estates, and from elderly people. The Farm Security Administration has had in mind the purchase only of tracts of land which were not actively farmed. The 103 tracts have been divided into 129 farm units averaging in size 80 to 160 acres. In the majority of cases the units have been laid out as originally designed by the Bureau of Reclamation. Each unit has had or is having suitable farm buildings constructed on it. It is planned that each unit shall have a house, barn, poultry house, garage, and tool house.

"With only two exceptions at the present time, all the units have some buildings constructed. There remain yet to be built nine new houses in addition to six old houses which are to be repaired and remodeled. Some outbuildings also are yet to be completed. It is anticipated that all major construction for this project will be completed by June 30, 1938. All of the families have been selected and, with the exception of one family, are now on the project."

CONTENTS

eft to right: E. K. Burlew, First Assistant Secretary and Budget Officer
Hon. Harold L. Ickes, Secretary of the Interior
Floyd E. Dotson, Chief Clerk, Department of the Interior

E. K. Burlew Takes Oath of Office

DMINISTRATIVE ASSISTANT and Budget fficer of the Department of the Interior be- mes First Assistant Secretary and Budget fficer by presidential appointment. Here he shown taking his oath of office in the office Secretary Ickes. Shown left to right: E. K. rlew, new appointee; Hon. Harold L. Ickes, cretary of the Interior and Public Works lministrator; Floyd E. Dotson, Chief Clerk the Department, administering the oath. statement about Mr. Burlew appeared on e inside of the front cover page of the pril issue of the Reclamation Era.

eclamation Reports to Secretary Burlew

Mr. Burlew has been given the assignment bureaus and offices and other duties as lows:

1. Budget Officer of the Department.
2. General supervision over personnel administration and business management.
   Chief Clerk of the Department.
   Chief, Division of Appointments.
   Chief, Division of Classification.
3. General Land Office.
4. Bureau of Reclamation.
5. Geological Survey.
6. Bureau of Mines.
7. Division of Grazing.
8. United States Board of Geographic Names.

In addition, he takes over the various committee assignments held by his predecessor, Secretary Walters, at the time of his death in November 1937.

Boulder Dam Power Plant

The main generators in operation are:

No.	*Date placed in operation*
Nevada No. 1	December 1936
Nevada No. 2	October 1936
Nevada No. 3	February 1937
Nevada No. 4	October 1936
Arizona No. 8	August 1937

Four generators under contract or erection with estimated date of operation are as follows:

Nevada No. 5	June 1938
Nevada No. 6	August 1938
Arizona No. 6	June 1939
Arizona No. 7	August 1939

PROGRESS
of Investigations of Projects

Arizona-California, Colorado River surveys: Under an agreement with Forest Service aerial mapping of irrigation possibilities from Boulder to Topock and Parker Dam to the International Boundary was in progress and the flying and photography practically completed.

California, Kings River—Pine Flat project: Investigation of Clarks Valley reservoir site was in progress.

Colorado, Blue River Transmountain Diversion: Geologic reports of Parshall, Two Forks, Dillon, and Tollgatee dam sites, and several tunnel lines completed.

Colorado, eastern slope surveys: Water supply and flood control studies continued of Cherry Creek, North Republican and Apishapa projects.

Idaho, Cabinet Gorge project: Power studies were continued including possibilitites of irrigation of lands in the vicinity of Coeur d'Alene by pumping from Coeur d'Alene Lake.

Southwest Idaho investigations: Diamond drilling was begun at Twin Springs dam site, and water supply studies continued on Payette and Salmon Rivers.

Idaho, Snake River storage: Drilling was continued at Burns Creek and Narrows dam sites on South Fork.

Nebraska, Bostwick project: Water supply studies were continued and topography of Rope Creek dam site near Alma.

North Dakota, Buford-Trenton project: Report of investigations completed.

Oklahoma: Water supply studies were in progress of Fort Supply project in vicinity of Beaver and of the Kenton project.

Oregon, Deschutes project: Construction funds were made available at end of April and preliminary activities on north unit in progress. Aerial surveys planned.

Oregon, Grande Ronde project: Designs of canals, and plans for relocation of railroad in progress and studies of Catherine Creek and Lower Grande Rande reservoir sites.

Oregon Medford project: Diamond drilling of reservoir sites planned for near future.

South Dakota, Black Hills project: Reports of the Angostura and Shade Hill projects in course of preparation.

Utah: Water supply studies were continued of Blue Bench, and Goosberry projects and studies of diamond drilling at Scofield dam site.

Utah-Idaho-Wyoming, Green River-Bear River surveys: Preparation being continued for an aerial map of Bear River Valley and water supply studies continued.

Colorado River Basin: Surveys and land classification were continued in Clark and Vernal-Ashley Valleys and along Price, and Virgin Rivers and Santa Clara Creek.

Log Crib Diversion Dam Constructed on Upper Snake River Project

By H. A. PARKER, *Construction Engineer, Upper Snake River Project*

THE DESIGN and construction of a log-crib dam is rather an unusual undertaking for the Bureau of Reclamation in these days when massive structures of concrete or of rolled earth and rock predominate. It takes us back to the early days of irrigation when a dam, if constructed at all, had to be built of the materials available at the site, a dam which could be built by the labor of the farmers who were to use it and without excessive expenditures in actual cash.

In view of the fact that comparatively few of such dams are being built at the present time, it is thought that a description of a small dam of this character might be of interest.

The Cascade Creek diversion dam is located on Cascade Creek, in northwestern Wyoming, just south of the Yellowstone National Park boundary, and approximately 1½ miles from the Grassy Lake storage dam. The drainage area tributary to the Grassy Lake reservoir is insufficient to supply the necessary water, so the plan of development included the diversion of Cascade Creek into the reservoir, thereby increasing the run-off available for storage by four or five times the amount that otherwise could be obtained. To accomplish the diversion, it was necessary to raise the water in Cascade Creek about 10 feet and build a diversion canal three-fourths of a mile long to reach the head of a draw leading down to the reservoir. The only structure required, other than the diversion dam, was a concrete check of the stop-plank type at the head of the canal to control the amount of water diverted.

Local Material Used in Construction

The choice of a log-crib dam was influenced by the fact that it was to be constructed in a heavily timbered country, 38 miles from the nearest railroad, and further, that more than 300 acres in the Grassy Lake reservoir were to be cleared. The distance from market discouraged the sale of much of the timber, and as it would have to be burned anyway, it seemed to be good economy to make use of some of it in the dam. Rock from the required canal excavation was also readily available for filling the cribs, and for riprap.

The diversion dam is constructed of logs placed in crib form, and thoroughly secured with drift pins at each intersection. The cribs are about 8 by 8 feet square, and completely filled with rock. The overflow crest of the dam is 140 feet long, with log crib abutments extending 20 feet into the banks at each end. The tops of the abutments are 5 feet higher than the crest. In cross section the dam has a total height of 14 feet, a vertical upstream face, a top width of 9 feet, and a downstream slope of 1 to 1. At the downstream toe a rock-filled log apron, 4 feet thick, extends out 17 feet. The channel is further protected from erosion by a 24-inch blanket of dumped riprap, extending out 20 feet from the end of the apron. Percolation through the dam is prevented by a double row of 2 by 12 vertical plank sheeting, with staggered joints placed against the upstream face of the logs. The sheeting extends downward for a minimum distance of 4 feet below the lowest log into a trench excavated in the rock foundation. The sheeting is extended horizontally for a distance of 20 feet beyond the outside limit of each abutment. Selected and tamped backfill was placed against the upstream side of the sheeting to an elevation within 2 feet of the crest of the dam from which point it was sloped upstream on a 3 to 1 slope and protected with 24 inches of riprap. The entire crest, slope, and apron were covered with logs laid close together and parallel to the axis of the dam. The specifications called for all logs in the cribs to have a minimum diameter of 14 inches and for the deck logs to be at least 8 inches in diameter.

Soft rock was encountered under the entire foundation which permitted starting the crib work at an elevation 2 to 4 feet higher than called for in the original design and saved materially in the amount of excavation and in the volume of the crib work.

The concrete intake structure at the head of the diversion canal is located about 50 feet upstream from the right abutment.

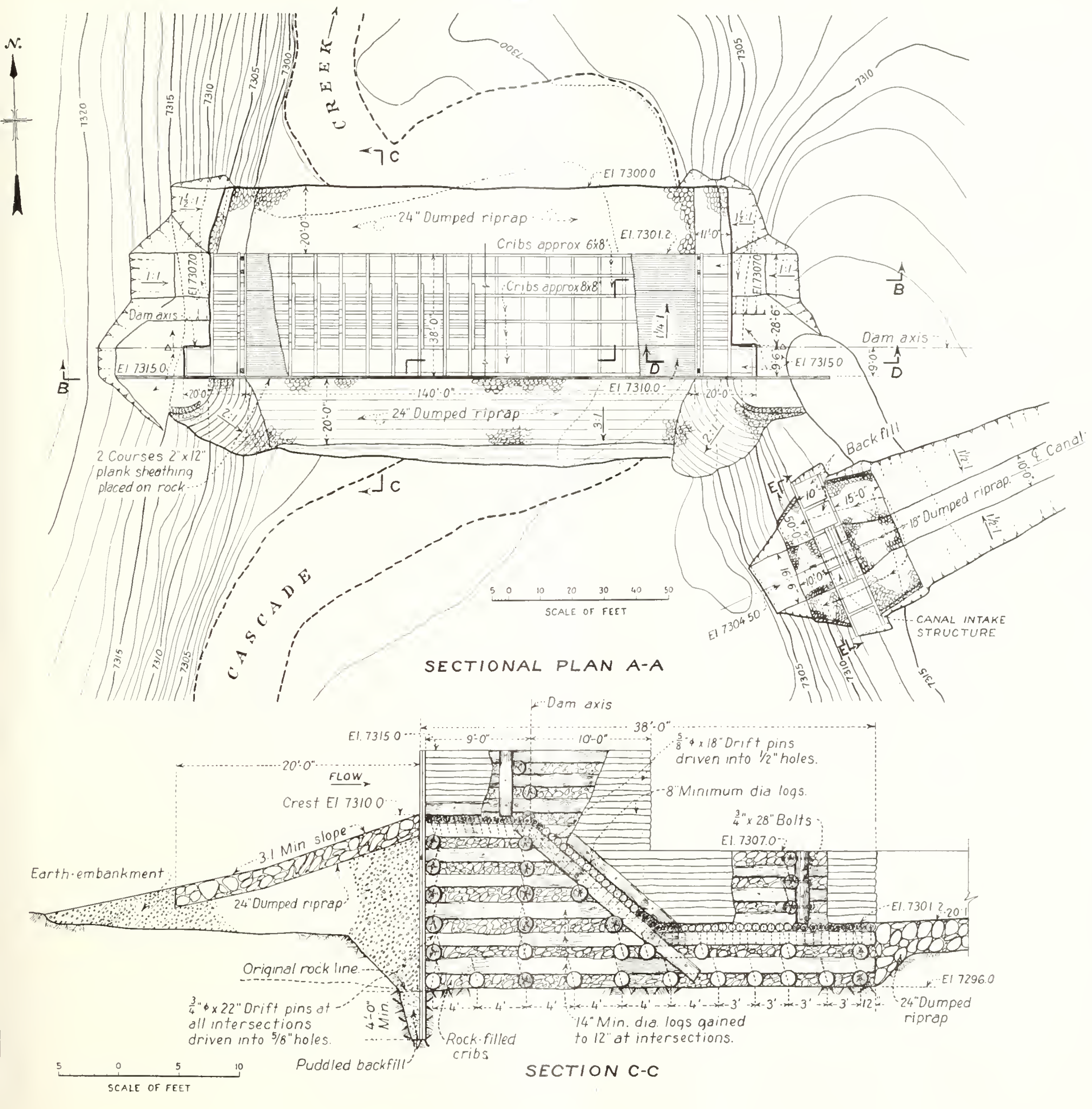
The dam was built by Bennett and Taylor of Los Angeles under contract dated July 28, 1937. Work was begun on August 2 and completed on October 16, 1937.

Details of the construction are shown in the accompanying picture and drawing. A picture of the completed dam appears on page 49 of the March Era.

The diversion canal is constructed with a capacity of 220 second-feet. It is anticipated

(*Continued on page 111*)

Cascade Creek diversion dam



UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
UPPER SNAKE RIVER PROJECT - IDAHO

CASCADE CREEK DIVERSION DAM
PLAN AND SECTION

Reclamation and the Home

By **MARSHALL N. DANA,** *Associate Editor, Oregon Journal, Portland, Oreg.*[1]
Former President National Reclamation Association

RECLAMATION AND THE HOME! The subject calls for a square look at that vanishing American foundation, the Home. It requires a view of the changed setting of the home. In a brief century and a half of American national experience the majority of the homes have left the country and gone to town. Of every 100 persons in the United States in 1790, 97 lived in the country and 3 in the cities. Now, of every 100 persons in this country, 44 live in the country and 56 in the cities. Of every 20 families a century and a half ago, 19 had to live in the country in order to feed one family in the city. Now 19 farm families can produce food for themselves, for 44 families in the city, and for 15 families abroad. These figures are based upon statements by the Secretary of Agriculture, and "Urbanism" report by the National Resources Committee.

The farm population in this country in 150 years has, of course, increased. It has multiplied 15 times. But the population of American cities has in the same period multiplied 300 times! More than a fifth of the people are in 22 cities. Two causes of general increase in population are the birth rate and immigration. But there is a third, so far as American cities are concerned, the folks who moved from farm to town. Yet the cities still look to the country for food and for men.

The great American land rush belongs to the past 150 years. Land-hungry, home-eager Americans spread across the valleys and the plains and up the shoe-string valleys. They took the land they found, whether fertile or poor, whether watered or dry. They learned, by trying, whether they could survive. Thus we account for the fact that recent inquiry disclosed approximately half of the food of the Nation is being produced on a tenth of the farm land and the other half on approximately nine-tenths of the tilled land. Thus, we account for the "farm slum" and for the tragic "dust bowl."

In the haphazard record of American agricultural development, reclamation has come to mean order and stability. I do not pretend to say there are not fine farms where unaided nature is the dependence for moisture. There are; but, under present-day tests, a reclamation project represents soil tested for fertility, a controlled and adequate water supply, and skill in soil preparation, planting, cultivation, harvesting, marketing, and suitable transportation between farm and town. A reclamation project produces a closer, more compact settlement and, thus, ends unnatural isolation.

Nor do I pretend to say that the only homes, happy in the experience and sweet in the memories of their occupants, are to be found on reclamation projects. But I do say that reclamation and homes are an inseparable combination. The effect of the improved methods required in reclamation farming is to produce better homes. Better homes will enjoy cheap electricity, they will be brightened with flowers and shade, they will be tied with good roads, they will let the world in with books, magazines, newspapers, and the radio, they will emphasize neighborliness and cooperation, and they will be occupied by intelligent, informed, and progressive people.

Reclamation's Contribution to the National Wealth

Federal reclamation has furnished homes for 840,000 such people. Allow them only an economic value of \$5,000 each and the addition to national wealth is \$4,200,000,000. This does not include the collateral wealth of communities, business, transportation, and utilities. Federal reclamation will furnish additional homes for many thousands. So great is the present eagerness to move from failure to success, from uncertain to certain water supply, and from unproductive to fertile acres, that the announcement of the opening to settlement of any reclamation project produces a land rush.

The ill-advised persons who oppose reclamation as a national policy are opposing homes, security, and national growth, they are opposing the production of better men and women, as well as of better homes and farms, and they are opposing a balance between farm and town, the balance that includes the unimpeded circulation of food and manufactured products with the aid of railways, highways, airways, and waterways. It is imperative to western agriculture that the water in the great storage reservoirs of the mountains be added to the vital fertility of the valleys in order to supply the food needs of western cities, to strike a balance between winter feed for livestock and summer range, and to maintain a harmonious activity in forests and mines. But it is equally imperative to national economy that the West have the economic balance permitted by reclamation in its relationship with the East. Only by means of a healthy, functioning, and growing region west of the 100th meridian can the East hope to have satisfactory markets for its industrial products, only thus can the East be sure of the big potatoes, the red apples, the dairy products, the vegetables and the specialties of reclamation upon which the Nation's daily menu now so much depends.

Reclamation homes steer a course between the hovels of discouraged agriculture and the multiple apartments of the cities. The tendency is toward neat and attractive cottages for single family residences on single family farms. That is the ideal. Such homes contain happiness and sustain education and religion. Such homes become the workshops where the elements of education, religion and culture produce character. Thus to the ceaseless flow of superior farm products between farm and town is added the flow of superior personalities who must be this Nation's reliance for leadership and its defense against deterioration.

It is impossible to have a satisfactory agriculture without a satisfying farm life; it is impossible to have a satisfying farm life without good farm homes.

The improved methods of reclamation farming tend to eradicate the blight of farm products; the homes that flourish upon reclamation projects tend to eradicate the blights of an artificial civilization from human beings.

Although its special products do not compete with the corn, wheat, and cotton staples, reclamation is uniquely adapted to the modern day, that, with its machines, power, transportation network, and demand for intelligent cooperation, permits one farm family to supply more than two others at home and almost one abroad.

Responsibility of Reclamation Settlers

The character which is a more important product of a reclamation farm than alfalfa, fruit, or great big potatoes, will represent the quality of honor. It will be honor practically applied in the relationships of project settlers with the Federal Government. Commissioner Page spoke very truly when he said, "The future of the Federal Reclamation policy rests with the project water users." A tendency to dodge, evade, or repudiate seriously assumed obligations would do more to defeat reclamation than its costs. When moratoria become alibis for payments that resources and honest purpose could meet, then the day grows dark for Federal reclamation policy.

And for the beneficiaries of reclamation by

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[1] Paper delivered at National Reclamation Conference.

irresponsibility to place weapons in the hands of those who are unfriendly to reclamation is to arm the forces of retrogression in the Nation as a whole. We need the bright, wholesome, and happy homes of reclamation projects to aid the country in its fight against juvenile delinquency, against disease and suicide, against organized crime and perversion. We cannot dispense with the contributions of such homes to ambition and opportunity, progress and accomplishment, liberty and peace.

Every reclamation project home ideally may be a little America where self government begins, where democracy rules the relationships of members of the family, where a mother's inspiration and a father's devotion may be reflected in the attainments of the children, and where the high standards of living symbolize the ascending standards of national life.

If home is where the heart is, the heart of the Nation beats in the American home.

Tentative Power Rates at Seminoe Dam, Kendrick Project, Wyoming

TENTATIVE RATES for the sale of power to be generated at Seminoe Dam, where the installation will have a capacity of 45,000 horsepower, were announced on May 5 by Secretary of the Interior Harold L. Ickes.

Seminoe Dam, the major engineering structure of the Kendrick Federal Reclamation project in Wyoming, will be completed in 1939. It will store in excess of 1,000,000 acre-feet of water for irrigation, regulation of the North Platte River, and for power, and will make possible the diversion from Alcova Dam, recently completed by the Bureau of Reclamation, of sufficient water for the irrigation of 35,000 acres of desert lands in the vicinity of Casper, Wyo.

Negotiations by the Bureau of Reclamation now are in progress with several prospective purchasers of power from the Seminoe Dam plant with a view toward the start of power generation.

The average of the approved rates for the various classes of energy are:

Firm energy (including a demand charge of $1.25 per kilowatt of 30-minute maximum demand per month) 6.3 to 7.4 mills per kilowatt-hour, depending upon volume and conditions under which the energy is accepted.

Firm energy (demand charge waived) 4 to 4.5 mills per kilowatt-hour, depending upon the volume and conditions of delivery.

Secondary energy 1.8 to 2 mills per kilowatt-hour.

The cost of the Kendrick project, when completed, is estimated at $20,000,000, of which $17,200,000 is to be repaid with interest by the sale of power.

The revenues from the Seminoe plant are estimated to range between an initial $400,000 to a maximum of $800,000 annually.

Consideration is being given in the negotiation of sale contracts to the fact that sale of power from a Government plant should be reflected in equitable rates to consumers. The difference between the amount of the cost of the project to be repaid by power revenues and the total cost will be repaid by the water users on the project lands, under the reclamation law, which provides payment in 40 years without interest.

Seminoe Dam, Kendrick Project, Wyoming, the 260-foot structure being built by the Bureau of Reclamation, will block the North Platte River as it curves through steep Seminoe Canyon, 55 miles southwest of Casper, Wyoming. Note the dam appears to lie lengthwise of the river, as the sharp curve in back of the dam is now unwatered

A Clerk's-Eye View of the Heart Mountain Division of the Shoshone Project

By JOHN H. McCLUER, *Senior Clerk*

THE RECENT and growing sentiment in favor of "long-range" planning in national affairs may some day quite conceivably be construed as having resulted from the fact that, from the date of its inception, the Bureau of Reclamation has proceeded to "build far into the future" with such enviable success as to impress upon even the most casual observer the importance of seeing with "the mind's eye" some 10, 20, or 50 years, or more, into the future.

The construction now in progress on the Heart Mountain Division of the Shoshone project is but one of many examples of this long-range planning. Twenty-eight years ago, in a narrow granite gorge on the Shoshone River, about 7 miles west of Cody, Wyo., the finishing touches were put on the Shoshone Dam, a rubble concrete arch, 329 feet in maximum height. Just west of the dam site, the north and south forks of the Shoshone River, each draining hundreds of square miles of the snow-covered Rockies, had converged, to flow through the narrow gorge of the Shoshone Canyon. But the Bureau of Reclamation had considered the thousands of dry but fertile acres comprising the terraces on either side of the Shoshone River Valley below the canyon, with the result that the Shoshone Dam appeared, like a giant wedge jammed there by a giant hand—that of the United States Government—in the narrow canyon of the river, to stem its flow and hold back the flood waters of the north and south forks and provide an available supply of some 456,000 acre-feet of water which would, some 5, or 10, or 50 years later, make those thousands of acres productive and livable.

Building Into the Future

The irrigation project, for the development of which the Shoshone Dam was primarily built, is known as the Shoshone project. Three divisions of the project, namely, Garland, Frannie, and Willwood, have been completed, and now, 28 years after the Shoshone Dam was "built far into the future", the Heart Mountain division is under construction.

Preliminary surveys of this division of the Shoshone project were made in 1911. Soil surveys and economic investigations were carried on in 1926 and 1927. In 1935, an allotment of $1,500,000, later reduced to $1,300,000, was made available from the Emergency Relief funds allocated to the Bureau of Reclamation, for beginning the construction of the canal system on the Heart Mountain division. The work was authorized as Official Project No. 5-35 of the Works Progress Administration, and, as the purpose of the Emergency Relief Act was primarily to provide funds to relieve unemployment, it will be interesting to note how large a part of the allotment granted to the division was used to provide employment, while carrying on the practice of building into the future, thus accomplishing a double objective.

For the divisions of the project previously completed, the water stored in the Shoshone Reservoir could be released into the Shoshone River and diverted to the divisions by means of dams several miles downstream from the Shoshone Dam. For the Heart Mountain division, however, water must be taken from the reservoir about 100 feet above stream bed. It was planned to release the water for this division through an intake located upstream and south of the Shoshone Dam, conduct it by some form of conduit to the lower end of the canyon, then across the Shoshone River and on, by means of a main canal, to the irrigable lands of the division.

Here again was evidence of long-range planning. It would not be sufficient merely to provide for supplying water for the Heart Mountain division. Sometime in the future, another division of the project, the Oregon Basin division, would be developed, so the conduit through the Shoshone Canyon must be designed of sufficient size so that the water it carried could be "divided" at the lower end of the conduit and part of it diverted, at some future time, to the Oregon Basin division.

Tunnel Construction

Pending the assignment of a construction engineer to the Heart Mountain division, Associate Engineer I. B. Hosig, of the Bureau of Reclamation, was sent, early in October 1935, to Cody, Wyo., to organize a field crew and direct the field work of securing necessary data for estimates of construction costs and for the preparation of specifications. Walter F. Kemp was assigned to the division as construction engineer and arrived to take active charge during the latter part of November. A whirlwind of activity on the part of the engineers, the field crews, and the Denver office staff, resulted in the issuance of invitations for bids under Specifications No. 656, for the construction of tunnels Nos. 1, 2, and 3, Shoshone Canyon Conduit, early in November 1935.

The contract for this construction was awarded to the Utah Construction Co. of Ogden, Utah, on January 6, 1936, and work was actually begun on February 21, 1936. The specifications called for the construction of three tunnels, joined by cut-and-cover sections, through and along the canyon slope on the south side of the Shoshone River, but investigations continued after the issuance of the specifications finally led to the conclusion that the most practicable form of conduit through the canyon would be one continuous tunnel. Approximately 3 miles of that tunnel, of 12-foot horseshoe section and concrete lined, are now nearing completion.

The tourist, motoring swiftly along the Canyon highway, on his way to or from the eastern entrance to Yellowstone National Park, will catch fleeting glimpses of the contractor's camp buildings against the rough and rugged background of the Canyon slope and may also wonder briefly whence came the two large spoil dumps that swell out from the entrances of the adits leading into the tunnel line. But he will probably not suspect that, beneath the rather forbidding surface of the slope and wall of the canyon, the hand of man is completing an artificial artery leading to the life-giving waters of the Shoshone Reservoir.

Working both ways from each of the two adits, the contractor's forces have drilled and blasted and dug and mucked their way through numerous formations—Pre-Cambrian granite, thinly bedded shales and sandstone, oolitic hematite, flat pebble conglomerates, and Madison limestone formation. Some portions of the tunnel had to be supported, while others needed no supports. Caves of varying sizes were encountered, one being so large as to require a revision of the plan for construction, transitions being made from concrete-lined tunnel to reinforced concrete flume, carried through the chamber on concrete piers, then into tunnel again. Noxious gases interfered at times with the prosecution of the work—just one of the difficulties encountered that had to be overcome.

Human brains and muscles and even human lives were built into the tunnel, two fatalities having occurred during excavation operations. Under direction of engineers, whose job it was to see that the excavation followed the correct lines and grades and whose responsi-

bility it was to make sure that sections driven toward each other should meet and run together smoothly, and under the critical eyes of inspectors who supervise the lining operations, the forces of the contractor have played, and are playing, their parts in this drama of accomplishment.

Building Other Features

Less appealing to the imagination, but no less important and exacting, are the other features that have been completed or are under construction on the division. A Government concrete testing laboratory and a Government warehouse were constructed by Contractor Charles M. Smith. Thousands of cubic yards of concrete aggregates were produced by the Taggart Construction Co. and are being used in lining the tunnel. Nearly 6 miles of main canal were built by the Morrison-Knudsen Co., Inc., of Boise, Idaho, and go meandering across the bench land on the north side of the Shoshone River, from a point near the mouth of the Shoshone Canyon on toward Heart Mountain. Two reinforced concrete siphons were required to carry the water under creek beds which cross the canal line. Sections of the canal had to be lined with concrete, and culverts, inlets, outlets, and bridges had to be built. A huge walking-type Monighan dragline with a 5-cubic-yard bucket ate its way rapidly along the canal line. Men and machines swarmed for a brief while over the terrain and then were gone, leaving a smooth, finished, and rather intriguing scar on the face of the earth.

The construction forces of James Crick are going ahead with the construction of the next unit of the main canal. The Northwestern Engineering Co. is constructing still another stretch of canal. On March 28, 1938, Tertelling & Sons were notified of the award of a contract for the construction of a short tunnel on the north side of the Shoshone River, a tunnel that will connect the inverted siphon which is to carry the water across the river with the portion of the canal already completed. Field engineering crews move over the division, leaving behind them thousands of stakes and flags, each of which plays a significant part in the construction and development of an irrigation system. From the headquarters office of the construction engineer in the Federal Building in Cody, invisible lines of dynamic, constructive force seem to be projected out over the division, and there is a conscious thrill in being a cog in what might be considered a huge machine that is slowly but surely transforming a vision into a reality.

Project Costs

Speaking of realities, what of the $1,300,000 of Emergency Relief funds that were poured into this huge machine to start it going? By June 30, 1938, it will practically all have been expended, and for what purposes? For direct pay-roll payments to contractors' and Government employees, $680,000 will have been spent. Of this amount, the contractors will have paid $490,250 for approximately 655,000 man-hours of work at an average hourly wage of about 75 cents. The Government will have paid $189,750 for approximately 261,000 man-hours of work at an average hourly wage of 72 cents. Of the remaining $650,000, the Government has paid about $90,000 for construction materials, engineering and office equipment and supplies, and $10,000 for freight and express and other transportation costs, while the contractors' expenditures for materials and supplies, equipment and transportation, have amounted to nearly $500,000. Thus it appears that, either directly or indirectly, the construction in progress on the Heart Mountain Division has been successful in accomplishing the objective of providing employment with Emergency Relief funds.

And 10, or 15, or 20 years hence, as the motorist rolls along the highway between Buffalo Bill's bustling tourist town of Cody, Wyo., and that thriving, growing center of the agricultural industry on the Shoshone Project, Powell, Wyo., he may see, if he will, in the hundreds of farms and homes that have magically appeared where only sagebrush and cactus and sand are now visible, that the other objective of the Bureau of Reclamation, that of "building far into the future," was also accomplished.

Heart Mountain, from which the division gets its name

Rural Electrification District

THE Organization of a Rural Electrification district to provide electricity for some 425 families on the Dead Ox Flat division of the Owyhee project and the Willow Creek division of the Vale project has been started.

Lake Mead Grows

WITH the coming of spring, Lake Mead, the largest man-made body of water again has begun to grow.

As the snow melts off the foothills of the Rocky Mountains, the Colorado River has risen until its flow into Lake Mead approximates 102,800 acre-feet a day, with less than 20,000 acre-feet being turned out each day through the outlets and penstocks at Boulder Dam.

For the first time, May 3, 1938, the water stored in Lake Mead reached 16,000,000 acre-feet, enough to cover 16,000,000 acres 1 foot deep, and enough to cover the States of Massachusetts and Connecticut to a depth of 2 feet.

Lake Mead now is 109 miles long, covering 93,150 acres, and reaching a maximum depth at Boulder Dam of almost 500 feet. At the present level of the surface of Lake Mead a head of 469 feet is provided for the five great generators which are turning in the powerhouse at the toe of the dam.

The peak flow of the Colorado River probably will not be reached until late next month when the flood caused by the melting of the snow pack on the high mountains may be expected. Precisely what may be expected in the way of total run-off this year is not known, but it is anticipated that Lake Mead will be filled much nearer to its capacity of 30,500,000 acre-feet before summer.

Lake Mead began filling in February 1935, when the outlets at Boulder Dam were closed for the first time. It had caught and held 15,250,000 acre-feet (half its capacity) of water excess to the needs of irrigators and power generators downstream in July 1937.

NOTE.—On May 31 the storage had increased to 18,772,000 acre-feet. *Editor.*

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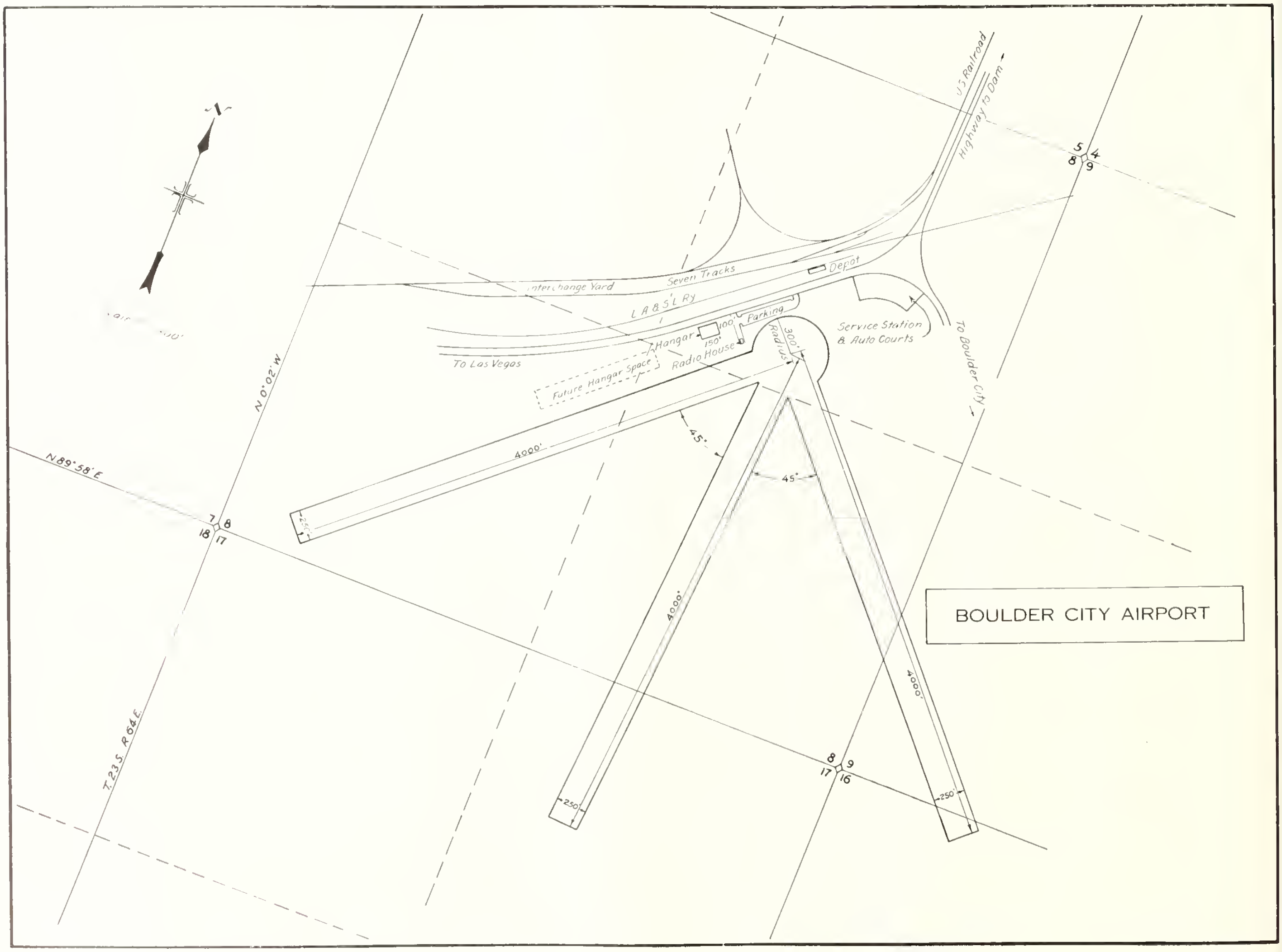
Transcontinental and Western Airways, Inc., Inaugurates Service at Boulder City

ON APRIL 3, the Transcontinental and Western Airways, Inc., created a new division point on its system, with the inauguration of an airmail and passenger service in and out of Boulder City. Boulder City replaces Winslow, Ariz., as the division point for the San Francisco branch route. Under the present schedule a plane arrives from San Francisco at 10:49 a. m., and returns to San Francisco at 3:20 p. m. The flight from Los Angeles arrives at 10:50 a. m., and takes off at 11:05 a. m. for eastern points. The plane from the East arrives at 2:03 p. m. and takes off from Los Angeles at 3:12 p. m. As soon as the field can be lighted, it is expected that additional flights will be added to the Boulder City schedule.

The airport now partially completed by the National Park Service, with the aid of the C. C. C. enrollees consists of three runways, each 5,300 feet in length, and 250 feet in width, and will be lengthened to 6,000 feet this spring. To date, two of the runways have been surfaced with a "Caliche" material which forms a very hard surface after having been sprinkled and rolled.

On March 29 and 30, T. W. A. under the supervision of Mr. Russell Delaney, air-line inspector for the Bureau of Air Commerce, conducted tests on the airport, using one of the large Douglass 21-passenger sky lounge planes, the largest plane now in use on any scheduled air line in this country.

The tests were conducted under conditions of no wind, and take-offs and landings were made in all possible directions with the airplane carrying a maximum capacity load. The results of the tests were very satisfactory in all instances and it was determined that in taking off in any direction sufficient speed could be built up before leaving the limits of the airport to insure safe operation should one motor fail at any point. The gradient of the center runway was found to be of aid in reducing the use of brakes and



still have ample room left on the 250- by 6,000-foot runway. To sum up, it was found that the slight gradient contributed greatly as a safety factor and did not present any hazard under any condition.

T. W. A. has leased the hangar now on the field from the Boulder Dam-Grand Canyon Tours, Inc., and plans are under way for the construction of a modern passenger depot to be constructed by the Boulder Dam-Grand Canyon Tours, Inc., and leased to T. W. A.

During the first 11 days of operation, 345 pounds of mail was dispatched from the local post office and in that time a total of 94 pounds of mail was received. During the same period 70 passengers arrived in Boulder City via T. W. A., while the number departing from the city was 129. F. M. Doolittle, Boulder city postmaster, announced that approximately 13,000 first flight covers, weighing 234 pounds were mailed from Boulder City the first day of operation.

Approximately 2,500 people gathered at the airport to witness the first planes arriving, on the day of the inauguration of the new schedules. The Las Vegas Horsemen's Association, and a few horsemen from Boulder City were at the airport, lending western atmosphere to the welcoming occasion.

Planes from Los Angeles and San Francisco with passengers alighting from the Los Angeles Plane

Log Crib Diversion Dam

(Concluded from page 104)

that a flow of 300 second-feet or more may reach the dam at times.

Cost of Cascade Creek Diversion Dam and Canal Headworks

Description	Quantity	Unit	Cost to United States	
			Unit	Total
Diversion and care of creek, and unwatering foundation.	(1)			$300
Clearing and grubbing	0.55	Acre	$250.00	138
Excavation, common, for structures.	2,115	Cu. yd.	.50	1,057
Excavation, rock, for structures.	501	do	11.00	5,511
Backfill	1,733	do	.30	520
Concrete	35.4	do	32.00	1,133
Steel reinforcement	3,764	Lb.	.074	278
Rock fill in cribs	2,179	Cu. yd.	1.75	3,813
Riprap	854	do	1.00	854
Logs, 8 to 14 inches in diameter.	7,892	Lin. ft.	.248	1,960
Logs over 14 inches in diameter.	10,280	do	.345	3,543
Timber in structures	20,379	M ft. b. m	108.52	2,212
Stop plank guides	352	Lb.	.233	82
Surveys, engineering, and inspection.				1,025
Total cost to United States, exclusive of canal excavation.				22,426

[1] Lump sum.

Net Profit

HIGH SCHOOL agricultural students in Future Farmer projects in Oregon during 1937 got an income from their activities amounting to $149,419.58, with the net return reaching $126,079.29.—*The Northwest.*

Black Hills Air-Mail Service

AIR-MAIL service for Black Hills towns was inaugurated on April 14 in connection with the Huron-Cheyenne route. The mail planes now stop at the Spearfish and Rapid City ports.

Bound Volume of THE RECLAMATION ERA *for 1937 Available*

BOUND VOLUMES of the 1937 issues of THE RECLAMATION ERA are now available. Field offices are entitled to copies in limited numbers. Copies are also available to subscribers and others at a price of $1 each, check or money order to be made payable to the Bureau of Reclamation, and forwarded to the Commissioner, Bureau of Reclamation, Washington, D. C.

Settlement of Land on Milk River Project

DEVELOPMENT and settlement of private lands on the Milk River project is being carried on by the Farm Security Administration. Practically all lands available for settlement are being acquired by local drought-stricken dry land farmers, and as the supply does not equal the demand, very little encouragement is being given to prospective settlers from other localities at this time. Approximately 100 new settlers will be operating project farms during 1938, and more than 500 applications for farms still remain on file with the Farm Security Administration, which cannot be satisfied at this time.

Technical Memoranda

IN view of the interest in the nearly 575 Technical Memoranda issued by this Bureau, there is an increasing demand for the lists and indexes issued, and the following rules have been made for the distribution of the three mimeographed lists, by the office of the Chief Engineer, Denver, Colo., to which office all applications should be made:

Price list, 26 pages, free.
Author index, 214 pages, price $5.
Subject index, 32 pages, price $1.

Cost of Surveys Columbia Basin Project

THE field cost of the surveys to March 31, 1938, of lands on the Columbia Basin project is as follows:

Surveys	Area acres	Cost	
		Unit	Total
Retracement	1,369,311	$0.122	$168,052.54
Monumenting	1,210,451		
Leveling	1,024,847	033	34,189.42
Topography	704,881	.336	236,957.68
Total			439,199.64

Construction of Alamogordo Dam

By CARL J. NIELSEN, *Assistant Engineer, Denver Office*

FOR MANY YEARS the principal storage unit for the 25,000 acres of land under the Carlsbad project in southeastern New Mexico was the McMillan Dam and Reservoir located on the Pecos River about 16 miles upstream from Carlsbad, N. Mex. A part of the storage for the project is also obtained from the Avalon Dam and Reservoir, 6 miles below the McMillan Dam. The McMillan Dam was constructed by the Pecos Irrigation & Investment Co. and was completed in 1894. From the time the dam was completed, the problem of silt accumulation in the reservoir has been of major importance, necessitating a number of improvements on the structure to increase the storage capacity of the reservoir and offset the losses incurred through silting. Considering the reservoir water surface to be at the elevation of the present spillway crest, the original capacity of the reservoir would have been approximately 90,000 acre-feet. Subsequent silting of the reservoir reduced the capacity to 40,000 acre-feet in 1932, a loss of 50,000 acre-feet of storage capacity.

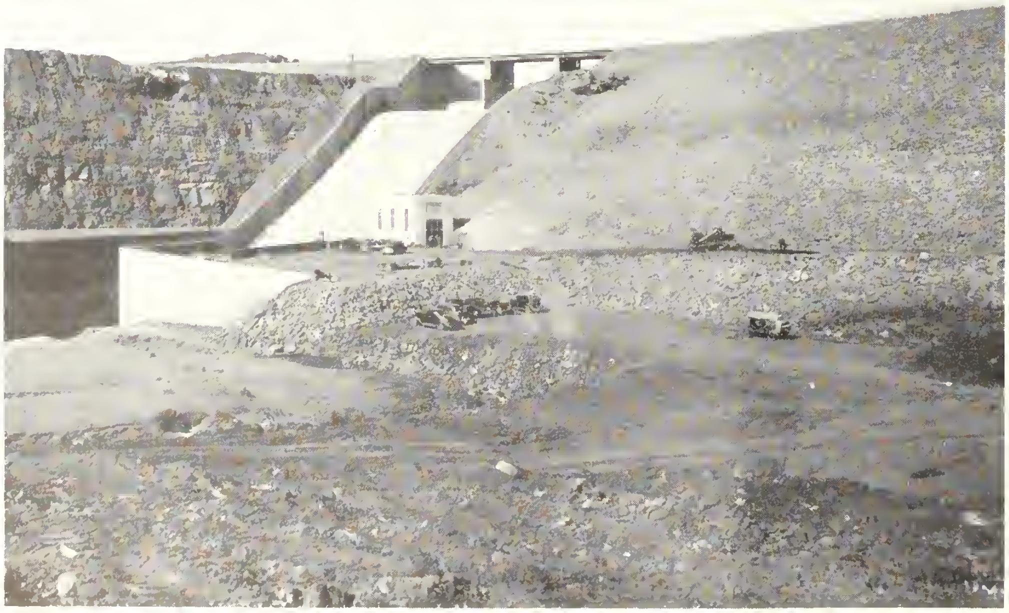
Another factor tending to reduce the effectiveness of the McMillan Dam is the character of the foundation materials. Large solution channels developed along certain soluble beds of gypsum and to a lesser extent of limestone underlying the reservoir area, thus permitting excessive losses. Efforts were made to correct this condition by constructing embankments to close off certain areas and by plugging the channels, but new openings continued to appear thus offsetting the gains made.

The reduction in reservoir storage capacity due to silting and leakage eventually became so great that it was difficult to provide for the needs of the project and assure a dependable water supply during periods of low runoff. A careful analysis was made of all factors involved and the results indicated that it would be less expensive and more satisfactory to construct a new dam at a different site rather than attempt to repair the defective conditions at McMillan Dam. After careful consideration the Alamogordo site on the Pecos River, 16 miles northwest of Fort Sumner, N. Mex., was selected. This site is located in an area of sandstone formation largely devoid of complicating conditions such as those adversely affecting the McMillan Dam site.

The allotment of funds for the construction of the dam was approved by the President on August 14, 1935, and $1,500,000 provided from Emergency Relief Administration funds to commence operations. This amount was later reduced to $1,000,000 and additional funds amounting to $1,100,000 were received from the Reclamation fund for the fiscal years of 1937 and 1938 to complete the work on the dam and perform the necessary concrete lining of the project canal system.

The original plans and specifications covering the construction of the Alamogordo Dam provided for an earth and rock-fill type dam about 1,550 feet in length and 135 feet in maximum height to create a reservoir of 166,000 acre-feet capacity. Bids were opened at Carlsbad, N. Mex., December 21, 1935, for specifications No. 660 covering the construction of the Alamogordo Dam. Thirteen bids were received and the Hallett Construction Co. of Crosby, Minn., submitted the low bid amounting to $1,132,547. The contract was awarded on January 25, 1936, and notice to proceed with the work was acknowledged by the contractor on February 18, 1936. Following a study of the unit prices received for the construction, a decision was made to revise the design of the dam by heightening the structure 7 feet and raising the reservoir water surface elevation 10 feet, thereby increasing the storage capacity some 51,000. The estimated additional cost resulting from the increased height of the dam was $175,188.10.

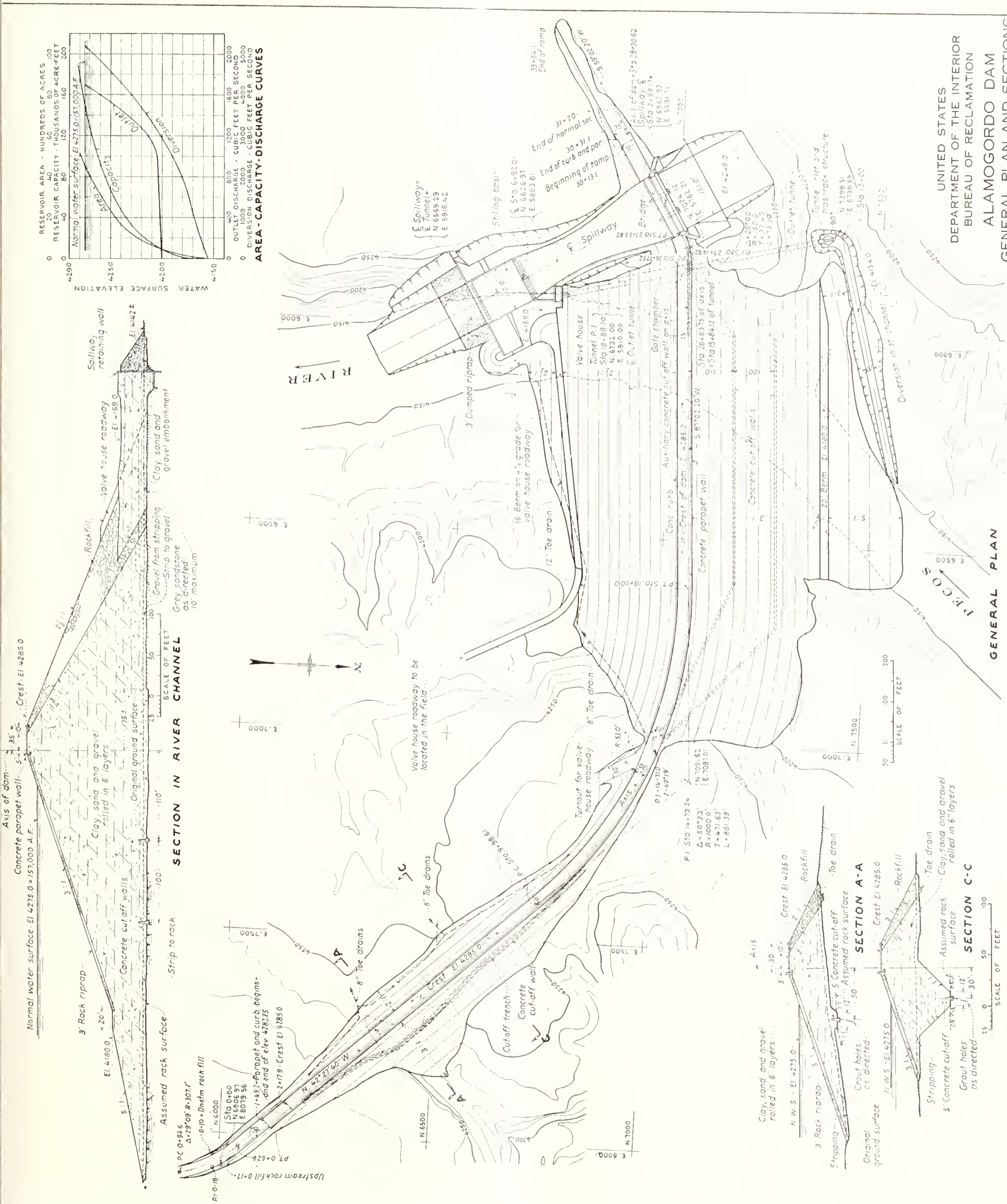
Downstream side of spillway, Alamogordo Dam



Dam and Reservoir

The Alamogordo Dam will create a reservoir of 156,750 acre-feet capacity, of which 8,750 acre-feet are below the outlet works intake structure, making 148,000 acre-feet of live storage available for use on the project. The reservoir at full capacity will extend about 12 miles above the dam and will cover an area of 4,600 acres. The dam is composed of two principal parts, the main structure across the river channel, and a dike extending from the left abutment along the rim of the reservoir. The main dam is an earth and rock-fill type structure, 1,595 feet in length and 148 feet in height above the lowest point of the foundation. The dike is of similar construction and extends 1,479 feet from the left abutment of the dam, with a maximum height of 55 feet above the natural ground surface.

The upstream face of the main dam was constructed on a 5 to 1 slope to a 20-foot berm at elevation 4,180, from which to the crest of the dam at elevation 4,285, a 3-foot layer of rock riprap on a 3 to 1 slope covers the embankment for protection against wave action. The downstream slope of the earth fill section was constructed on a $1\frac{3}{4}$ to 1 slope, which is covered by rock fill on a finished slope of $2\frac{1}{2}$


UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
ALAMOGORDO DAM
GENERAL PLAN AND SECTIONS
GENERAL PLAN
PECOS
RIVER
SECTION IN RIVER CHANNEL
SECTION A-A
SECTION C-C
AREA-CAPACITY-DISCHARGE CURVES
RESERVOIR AREA - HUNDREDS OF ACRES
RESERVOIR CAPACITY - THOUSANDS OF ACRE-FEET
OUTLET DISCHARGE - CUBIC FEET PER SECOND
DIVERSION DISCHARGE - CUBIC FEET PER SECOND
WATER SURFACE ELEVATION
Normal water surface - El 4275.0 = 157,000 A.F.
Concrete parapet wall
Axis of dam
Crest El 4285.0
Clay, sand and gravel rolled in 6" layers
Concrete cut off walls
Original ground surface
Assumed rock surface
Strip to rock
3' Rack riprap
Rockfill
Valve house roadway
Spillway retaining wall
Clay, sand and gravel embankment
Gravel from stripping
Grey sandstone as directed
SCALE OF FEET
Spillway
Stilling basin
Bridge
Valve house
Gate chamber
Outlet tunnel
Concrete curb
Concrete parapet wall
Concrete cut off walls
Auxiliary concrete cut off wall on axis
Toe drain
8" Toe drains
Cutoff trench
Concrete cut-off wall
Valve house roadway to be located in the field
Turnout for valve house roadway
3' Dumped riprap
Diversion inlet channel
Tunnel inlet and trashrack structure
Grout holes as directed
Stripping
5' Concrete cut-off
Assumed rock surface

Spillway, dam, and dike looking east

to 1 to add stability to the dam. A 16-foot berm on a 4-percent grade, crossing the lower end of the downstream face, will be used as a roadway to the valve house. The upstream face of the dike was constructed on a 3 to 1 slope and is covered from the foundation to the crest with a 3-foot layer of rock riprap. The downstream slope of the earth-fill section is 1½ to 1, which is covered by rock fill on a finished slope of 2 to 1. A roadway is provided on the crest of the dam, 35 feet in width on the main structure and 30 feet in width on the dike. A concrete parapet wall and curb for the protection of the crest extend from station 1+49.2 to station 30+31.1, a distance of 2,881.9 feet.

Two concrete cut-off walls were constructed in the foundation for the main dam. The walls range in height from a maximum of 10 feet to a minimum of 5 feet and are supported on footings 3 feet in width extending to a minimum depth of 3 feet into the foundation rock. An auxiliary cut-off wall also was provided on the steep slope of the right abutment along the axis of the dam. A 5-foot concrete cut-off wall was constructed in an open-cut trench in the foundation for the dike.

Pressure grouting of the foundation was performed to seal the joints, crevices, and contacts in the foundation rock and secure a relatively tight foundation free from excessive leakage. The plan of the foundation grouting for the main dam consisted of two complete curtains of grout along the cut-off walls, a curtain along the auxiliary wall on the right abutment, and two additional curtains on the left abutment. A single curtain of grout was provided across the dike section and holes were drilled and grouted in a manner similar to that used on the main dam.

Spillway

The spillway designed to discharge 56,000 cubic feet per second with reservoir water surface at elevation 4,275, is located on the right abutment. The inlet at elevation 4,249 is 151 feet in width. The crest at elevation 4,254 is surmounted by three 45- by 21-foot radial gates separated by 8-foot piers located at the one-third points along the crest. The gates are designed for automatic operation with the fluctuations in the reservoir water surface. Emergency hoists are located on an 11-foot operating platform spanning the gate section. The roadway over the dam is carried over the spillway at the gate section on an 18-foot reinforced concrete bridge located immediately downstream from the radial gate hoist deck. The chute section below the crest is approximately 365 feet in length measured horizontally and leads to a stilling pool 110 feet in width and 124 feet 8 inches in length with dentated sills at the inlet and outlet ends. In plan, the chute section closely resembles an hour glass, contracting in the center and enlarging at each end.

Outlet Works

The outlet tunnel, which served as a diversion tunnel during the construction period, is located in the right abutment and is approximately 635 feet in length from the trashrack structure to the outlet portal. The upstream portion of the tunnel above the axis of the dam is a concrete lined circula section 10 feet in diameter and 312 feet i length with a slope of 0.008. Downstrea from the axis of the dam the shape of th tunnel is changed to an 11- by 17-foot 6-inc concrete lined horseshoe section 250 feet i length with a slope of 0.004. No particula difficulties were experienced in the construc tion of the tunnel except that a layer clay encountered near the roof of the tunn in the circular section necessitated the use some liner plates for support. The concret linings were heavily reinforced and hav minimum thicknesses of 8 inches for the ci cular section and 12 inches for the horsesh section. High pressure grouting was pe formed in the circular section of the tunn and the gate chamber to form a curtain grout along the axis of the dam complete through the right abutment to the outl tunnel. Grouting in the horseshoe sectio was confined to low pressures to fill the void between the concrete lining and the rock.

The trashrack and intake structure hexagonal in plan, 20 feet in width betwee faces and 68.5 feet in height. Two 9-fo 9-inch by 8-foot 6-inch openings protected b trash bars are provided on each side of th structure with intake sills at elevations 4,20 and 4,211. At the end of the circular tu nel section two 5- by 5-foot high-pressu slide gates are located in a concrete plug fo emergency control of the flow. From th gates the flow is carried through two 66-inc diameter welded plate steel outlet pip about 285 feet in length. The flow throug the outlet works is controlled by two 54-inc balanced needle valves at the end of eac outlet pipe discharging into the spillwa stilling basin. The valves are located in valve house at the end of the tunnel i which the controls for the valves and th emergency gates are also located. Th maximum discharge capacity of the outle works is estimated to be 1,700 cubic feet pe second.

Construction Features

Work was commenced by the contracto on the construction of the dam and appurte nant features on March 1, 1936, and all wor under the specifications was completed De cember 15, 1937, five months in advance o the required date for completion. A genera summary of the work performed under th contract is presented below:

Excavation: Spillway, outlet works, stri ping, drains and trenches, foundation, eart and rock borrow operations—2,572,894 cubi yards.

Embankment: Earth and rock fill, ripra and backfill—1,935,025 cubic yards.

Concrete: Spillway, tunnel lining, cut-o walls, control house, etc.—22,894 cubic yard

Pressure grouting: 69,926 cubic feet.

Reinforcement steel: 1,920,023 pounds.

Metalwork: Gates, valves, outlet pipes, pip and fittings, trashrack, liner plates, miscella neous—642,935 pounds.

The excavation of the outlet tunnel was commenced on March 12, 1936, and the river diverted through the tunnel on November 13, 1936. The tunnel was completed for diversion in advance of the stilling pool and it was necessary to construct a temporary flume from the outlet tunnel to the river channel to carry the flow away from the construction work on the stilling pool.

Embankment

The limited capacity of the diversion tunnel made necessary a rapid program of construction to complete the earth embankment between the time the river was diverted and the time of the usual flood period in the spring and summer months. Prior to the completion of stripping on the foundation and the diversion of the river, some earth fill was placed in the river bottom area on the left side of the river channel. Excellent progress was made on the construction of the embankment from December 1936 to April 1937, at which time the dam had been raised to elevation 4,273, and about 90 percent of the total yardage had been placed. Operations were then discontinued to permit the completion of the foundation for the dike and the placing of riprap and rock fill on the slopes of the dam. Earth fill operations were resumed in June 1937, and the embankment was completed on October 25, 1937.

The embankment was divided into three major sections to conform to the divisions in the borrow areas. The selected fines containing a larger percentage of clays were assigned to the upstream central third of the fill; the selected medium, a mixture of topsoil and sand and gravel, was placed in the upstream and central portions; and the selected coarse, containing less clay, was placed in the downstream portion. This method of material classification proved very satisfactory in the construction of the earth fill, the three gradings being transported from the borrow areas to their respective locations in the embankment without difficulty.

Rock Fill and Riprap

The rock obtained from the required excavation for the spillway structure was placed in the downstream rock-fill section of the dam. The red sandstone from the spillway excavation deteriorated rapidly in the stockpiles, but the grey standstone proved durable so it was separated from the red sandstone and stockpiled for later use in the construction of a 3-foot veneer on the downstream face of the dam. The supply of grey sandstone being limited in the spillway excavation, a rock borrow pit at the east end of the dike was used to supply the necessary rock. The red sandstone was placed next to the earth embankment and covered with 3 feet of grey sandstone. The materials were placed in horizontal layers approximately 3 feet in thickness and during the placing of each layer the fine material was sluiced into the voids. The outer surface of the fill was hand worked to such an extent as to fill the voids and to keep a reasonably uniform surface. No rock larger than 1 cubic yard in volume was permitted in the fill. A total of 265,748 cubic yards of rock was placed in the downstream rock fill and the work completed in August 1937.

A small amount of material was placed in the 3-foot layer of rock riprap on the upstream face of the dam before the river was diverted through the outlet tunnel. The major riprapping operations were commenced after the embankment had reached elevation 4,265. The rock used in the riprap was the best material available and was of gray sandstone secured from the spillway excavation and the borrow pit. The rock was dumped in irregular piles and it was necessary to blast the oversize rock and bar and handle small rock to fill the voids and prepare a reasonably smooth surface. The major portion of the riprap was placed from March 1937 to July 1937, all work being completed in October 1937. The riprap on the dike was placed as the earth fill was raised. A total of 52,823 cubic yards of rock was placed on the upstream slopes of the dam and dike.

A 3-foot layer of selected rock riprap also was placed beyond the concrete walls and floor of the stilling basin for a distance of 75 feet to prevent erosion. A total of 1,826 cubic yards of rock was placed in this part of the work.

Flood

Heavy rains on the watershed of the Pecos River above the Alamogordo Dam from May 27 to June 4, 1937, resulted in a maximum flow in the river at Santa Rosa, N. Mex., estimated at 56,000 cubic feet per second, the highest recorded discharge at that point. The water surface elevation in the reservoir was raised from 4,160 on May 27, to 4,260.9 on June 3, increasing the storage in the reservoir to almost 100,000 acre-feet. The maximum estimated flow into the reservoir was 75,000 second-feet for a period of 1 hour on June 2. The estimated maximum discharge of the partially completed spillway was 17,000 second-feet, and of the outlet tunnel 4,800 second-feet. The partially completed Alamogordo Dam was credited with having averted serious flood damage in the Pecos River Valley at Fort Sumner, Roswell and Carlsbad, N. Mex.

Parapet and Curb Walls

Settlement plugs were placed in the upstream and downstream faces of the dam during June 1937, on which observations were made at 2-week intervals to determine the amount of settlement in the dam. These observations after a period of 3 months indicated no perceptible settlement in the fill, and the construction of the curb and parapet walls was commenced on September 13, 1937.

Work was commenced on the east end of the dam. The parapet wall was constructed in two sections, the base and part of the wall below the crest being placed first and the exposed part of the wall above the crest being placed second.

Installation of Gates, Valves and Outlet Pipes

To permit the early storage of water in the reservoir, temporary gates were installed in the trashrack structure at the diversion tunnel opening for the regulation of discharge prior to the installation of the high-pressure gates, outlet pipes and needle valves. The installation of the high-pressure slide gates was performed without difficulty, about 3 weeks being required to completely install the gates and control lines, and place the remaining concrete in the gate chamber. The installation of the 66-inch diameter outlet pipes was commenced on October 12, 1937. The pipes were pulled together with chain blocks, blocked up to grade, and then welded. After the pipes were installed, the needle valves were placed in the control house and the work completed on December 15, 1937.

No provisions were made in the specifications for the installation of the spillway radial gates. This work was undertaken by Government forces in November 1937.

Installation of Test Apparatus in the Dam

Hydrostatic pressure indicators were installed in the embankment of the main dam for experimental purposes to determine the path of the percolating waters through the earth materials and to secure data for the preparation of designs on future rolled earth-fill dams. The instruments were set in holes drilled along two lines perpendicular to the axis of the dam. They were grouted in place and the connections carried in sealed copper tubing to the crest of the dam where the observations are made. This work was performed by Government forces.

Costs

A general summary of the costs to January 1, 1938, not including all of the cost of installing spillway gates, is presented below:

Feature	Contract	Materials furnished by United States	Total
Dam and dike	$910,868.41	$72,547.04	$983,415.45
Spillway	375,820.17	103,376.28	479,196.45
Outlet works	173,237.94	93,598.42	266,836.36
Road to damsite, etc.	319.24	0	319.24
Subtotal	1,460,245.76	269,521.74	1,729,767.50
Work performed by United States		31,589.94	31,589.94
Subtotal	1,460,245.76	301,111.68	1,761,357.44
Engineering and other overhead expenses		196,541.51	196,541.51
Total	1,460,245.76	497,653.19	1,957,898.95

Framing a Weed Control Program for the Uncompahgre Valley

By W. H. MERCER, *Uncompahgre Valley Water Users Association*

DURING the season 1937 the Board of Directors of the Water Users Association, the Agricultural Agents of Montrose and Delta Counties, members of the State Extension Service, civic organizations and officials of the Bureau of Reclamation have worked together in the preparation of a weed control and eradication program adaptable to the Uncompahgre Valley. The members of the Board of Directors have been sympathetic and open minded toward all intelligent efforts to work out some effective method of controlling weed growth on the project. J. Frank Anderson, Floyd Beach, and J. Carl Wilson, members of the Weed Committee of the Board, together with Jesse R. Thompson, Acting Superintendent, have been particularly sympathetic and cooperative in this work. Rodney Tucker, weed specialist of the Extension Service, has inspected the weed control work and addressed weed control meetings on numerous visits to the project. L. H. Mitchell, Field Supervisor of the Bureau of Reclamation, and C. B. Elliott, Construction Engineer, have rendered valuable counsel and assistance.

At the present time, it is becoming quite generally recognized that any effective weed control program must eventually contemplate the complete suppression of all weed growth and subsequent prevention of weed seed formation on the ditch banks, along fences, roadsides, and in waste places as well as on the cultivated lands of the project. Stock-poisoning weeds and other noxious weeds, such as Wild Morning Glory or Bindweed, Burdock, White Top, Canada Thistle, Knapweed, and Poverty Weed, have become so generally interspersed with other weeds and vegetation in those places that any less comprehensive program would not effectively accomplish the objective sought. Suitable steps should also be taken to prevent the introduction of new weeds through contaminated crop seed or through waste dumped from freight cars or trucks. Constant watch should be kept for newly arrived weeds and effective measures taken to eradicate them before they gain a foothold.

With this comprehensive program in view, an educational campaign was carried out during the summer in the newspapers of the project. An article on some phase of the weed problem, prepared by one of the County Agents or some other authority on weed eradication work, was submitted to the papers on alternate Thursdays throughout the summer and fall.

Eradication Methods Studied

Work on a clean culture plot of Wild Morning Glories begun in 1936 was continued this year. Owing to the wide interest in clean cultivation as a practical method for the eradication of perennial weeds, especially where large areas are infested, it might be well to give the history of this plot. The plot for this interesting experiment was located by Field Supervisor Mitchell in an alfalfa field where Wild Morning Glories had taken complete possession of the ground. On June 13, 1936, it was plowed about 6 inches deep. The weeds were then in full bloom and completely covered the ground with a thick mat of vines. During the balance of the season all growth above ground was prevented by using a blade, set to cut about 4 inches deep, whenever sprouts were observed about to come through the ground. On June 24, the blade was used the first time and underground cutting was continued at intervals thereafter until October 27, when the blade was used for the nineteenth time—an average interval between cuttings of less than 7 days. However, from July 6 until September 15 the interval between cuttings was only about 4 days. The first time in 1937 it was necessary to use the blade was May 14, and cutting was continued intermittently throughout the season until October 20, when the blade was used for the nineteenth time, including two plowings on July 16 and 28. During the entire season no growth was permitted above the ground. The second year's work on this plot will be concluded on June 13, 1938.

Spraying experiments with calcium chlorate under the trade name of Atlacide were continued this year in a somewhat larger way. Tests were made to determine the minimum quantity which could be used in order to kill all growth above ground. Satisfactory results were secured with an application of less than one-half pound per square rod. The chemical was applied with a small hand-operated apparatus. Most of the annuals were completely killed. Perennial Peppergrass, Burdock, and Russian Knapweed were completely killed in all the experiments made. However, as the minimum quantity used on these weeds was 2 pounds or more per square rod, more work will have to be done before final conclusions can be drawn on the minimum quantity that can be used in order to secure a complete kill.

Burning experiments were carried out on various parts of the project and at differe times during the season. Although mor than 2 miles of ditch banks were burne with an old-style burner owned by the Wate Users Association. The weeds burned i cluded practically every species growing o the project. In no case did burning ki growth below ground.

Notes were taken on the growth of straw berry clover planted last year, and furthe observations were made of the weed-compet ing value and pasture value of this clove which has been found growing on severa farms of the project. These data tended t confirm previous information obtained on thi valuable clover. It can be highly recom mended as a pasture crop for this project be cause of its high feed value and its ability t fight weeds and to withstand adverse condi tions of soil and water.

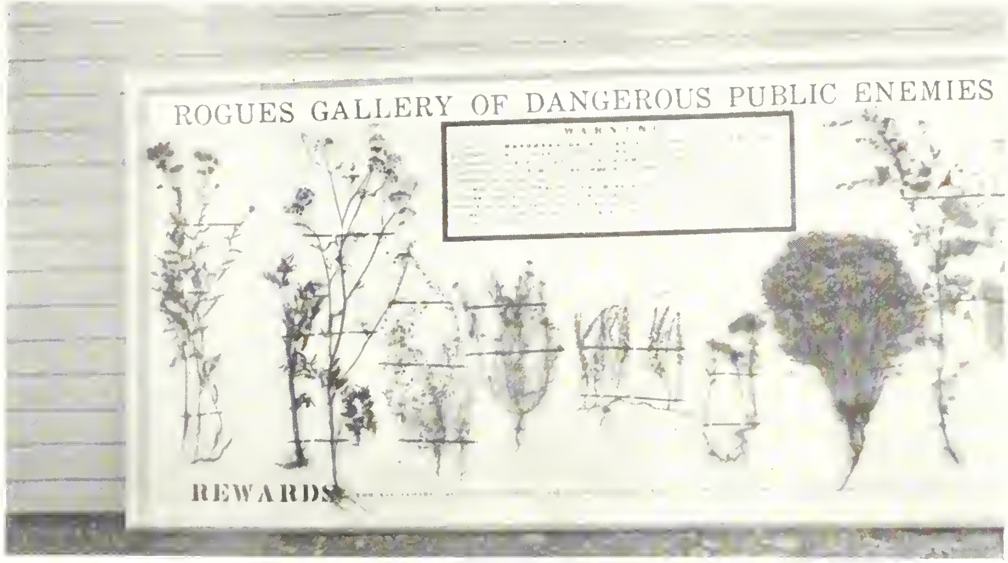
A committee consisting of the Weed Com mittee of the Board of Directors, together wit Acting Superintendent J. R. Thompson an W. H. Mercer, visited the Salt River projec at Phoenix, Ariz., on September 2 and 3 t make a study of the methods employed o that project to exterminate weeds on ditc banks. The committee learned that burnin with large torches was the exclusive metho adopted there. They made a very carefu examination of the apparatus used an watched the burners in action in order to lear the technique. Weed species present and thei prevalence on the project were noted an much consideration was given to climatic an other factors which might have some bearin in comparing the weed problems of the tw projects.

Weed Census Taken

A weed census was taken by the ditch rid ers at the same time the crop census wa taken. Questions were asked each farme relative to the presence of and damage du to any one or more of the five worst weed found growing on the project. Wild Morning Glory was first in prevalence and distributio with a number of other pernicious weed running neck and neck for other undesirabl features.

As part of the educational program, a wee exhibit was prepared and shown at the Mont rose County Fair, after which it was place in the agricultural department of the Delt High School. Typical specimens of Canad Thistle, Poison Hemlock, Wild Morning-Glory Whorled Milkweed, Russian Knapweed, Whit

Top, Poverty Weed, Cocklebur, and Burdock, including their underground root systems, were prepared and mounted on a 6- by 12-foot panel. Across the top of this exhibit the group title for these noxious weeds read "ROGUES GALLERY OF DANGEROUS PUBLIC ENEMIES." Directly below appeared this "WARNING": "It is reported on reliable authority that these enemies of civilization have been seen in the Uncompahgre Valley. It is the highest duty of every citizen to fight them wherever found with every resource at his command. Some of the weapons that have been used successfully in other communities are an aroused public sentiment and an individual determination and effort to exterminate them. Other primary weapons consist of fire and chemicals, the plow, the blade, and the hoe." The name of the weed with a brief description of its common characteristics was given for each specimen. At the bottom of the exhibit was proclaimed in large lettering: "REWARDS—Immense rewards of public approval will be paid to any citizen who exterminates any one of these pests." This exhibit attracted wide interest and attention.



Weed exhibit prepared for Montrose County Fair

New Goals Ahead

In concluding, it is quite obvious that it is difficult to estimate the value of the weed control work undertaken on the Uncompahgre project. The newspaper articles and the weed exhibit have played an important part in educating the public to the menace of weeds and the types now present on the project.

The search for useful plants to occupy ground now covered with weeds has already been rewarded by the discovery that strawberry clover and bromegrass are two of the best to be had for the purpose.

The clean culture work on Wild Morning-Glories tends to indicate that lands infested with these weeds will have to be withdrawn from cultivation for a period of at least 2 years if complete extermination is the objective sought. Total eradication appears to be a hopeless task as long as this weed is permitted to grow and ripen seed along fences, ditches, and other uncultivated areas. The use of chemicals on this weed in cultivated fields has not proven to be an unqualified success. Usually scattering plants are left, and the land is rendered unproductive for a number of years, or the cost is so great as to be prohibitive for general use.

Burning and spraying experiments on the Uncompahgre project, although made with antequated equipment, have progressed to the point where it is possible to predict that some combination of these methods of destroying weeds ultimately will prove to be feasible from the standpoint of cost. An illustration of the possibilities in this method of destroying weeds will be supplied by a description of one of the experiments carried out this past season. On August 21 a strip of ditch bank 140 rods in length was sprayed at a cost of 3 cents per square rod for chemicals. Anyone familiar with spraying apparatus equipped for this work will readily see how cheaply a mile of ditch could be sprayed. Ten days after the spraying was done the ditch bank had all the appearances of mid-December. Parts of it could be burned by simply tossing a match into the dried weeds. Later on, this strip of ditch bank was burned off with a small burner in 5 hours. Further experimental work must be done on a larger scale than carried out heretofore on the project before an accurate cost per mile can be determined and to work out many details of equipment and technique.

The visit to the Salt River project developed the outstanding fact that the two projects have very little in common, relative to their weed problems, with which to make comparisons. Stock-poisoning weeds and perennials, with the exception of Johnson grass, are practically unknown on the Salt River project. A weed eradication program will have to be developed exclusively for the Uncompahgre project from data accumulated through experimental work carried out on the project. Whether this program, with or without modification, will be adaptable to any other irrigation project necessarily will remain problematical until further technical research work clears it up.

Irrigation in Foreign Countries
Don Martin Project, Mexico

THE DON MARTIN PROJECT is located in the State of Coahuila, on the Rio Salado, a tributary of the Rio Grande. The Don Martin Dam is 65 miles west of Laredo, Tex. It was begun in 1927 and completed in 1930, and forms a lake 10 miles wide and 16 miles long with a capacity of 1,124,000 acre-feet.

The development of the project has been very rapid resulting in the following increase in area cropped, number of farms, and crop values:

Year	Number of farms	Area (acres)		Value crops	
		Per farm	Total	Total	Per acre
1931	456	52	23,700	$255,000	$10.75
1932	1,053	35	36,800	425,000	11.55
1933	1,313	59½	78,200	1,064,000	13.60
1934	1,478	63	93,200	2,769,000	29.70
1935	1,694	68	115,000	4,176,800	36.30

When the lands were opened to settlement, as few of the settlers had money the Government permitted them to work the land on the share-cropper plan, the money obtained from the first crop enabling the farmer to purchase an equity in his farm. The total population is estimated as 36,000, and the average number of children per family is six.

Cotton is the principal crop, and 12,000 bales probably will be harvested in 1938 against three times this amount in 1936. This reduction has been due in a large part to the drought.

It was expected that about 160,000 acres could be irrigated, but with the recent water shortage, it has been estimated that the limit of irrigated area has been reached.

The total cost of the project, including preparation of land, roads, drains, etc., is $14,968,000.—W. I. S.

Bind Weed District Established in Mitchell Valley

By C. W. NIBLER, *Agricultural Agent of Scotts Bluff County, Nebr.*

FARMERS of Mitchell Valley Precinct in Scotts Bluff County, Nebr., are first to organize into a Bind Weed District under provisions of the Weed Law, passed by the Nebraska legislature in 1937.

Interest in bindweed eradication was definitely aroused in this area as a result of a bindweed tour sponsored by C. W. Nibler, agricultural agent of Scotts Bluff County. That, along with the passage of the Weed Law, encouraged these progressive farmers to take definite steps.

Although bindweed does not cover large areas in this valley, the patches are numerous and there is serious danger of the weed spreading rapidly, because of irrigation. These farmers, realizing that it would be much cheaper to eradicate this menace under present conditions, decided to organize into a weed eradication district. Active support to this movement was given by the Mitchell Valley Community Club—an organization of the farmers in this territory.

The provisions of the Weed Law, provide that 51 percent of the resident land owners of a designated area must petition the county commissioner, in order to establish a weed district. The resulting petition contained the signatures of 94 percent of the resident landowners, individuals owning 80 percent of the land. This district comprises 28,000 acres.

As further provided by the law, a survey was conducted by the representatives of the Division of Weed Control of the Department of Agriculture and Inspection, to determine the feasibility of district organization. Organization was recommended by the directors and the State Weed Advisory Committee. The petition, recommendations, maps and other information were presented at a hearing before the county commissioners. In a vote taken of the 125 landowners, present at the hearing, three were opposed to the organization. The county commissioners ordered the district to be organized.

A meeting of the landowners of the district was again called for the purpose of electing weed supervisors from their number. Five weed supervisors were elected and it is their duty to administer and supervise the operation of the district. Taxes for operation and eradication purposes are levied on the land owners, according to the benefits they receive.

The director of the Department of Agriculture and Inspection and the State Advisory Weed Committee cooperate with the weed supervisors in carrying out practical and economical plans of eradication. The State weed advisory committee consists of W. H. Brokaw, Agricultural Extension Director, Dr. F. D. Keim, Chairman of the Department of Agronomy of the Agricultural College, Howard Walgren, president of the Nebraska Crop Growers Association and Dearle Baker, president of the Nebraska Horticultural Society.

Since the organization of the district has been completed, farmers of the Mitchell Valley have high hopes of seeing this area bindweed free in the next few years.

So that farmers may be protected from reinfestation, the Weed Law prohibits the sale of feed or seed containing bindweed seed until this seed has been removed or destroyed. Farmers buying seed are advised to send samples to the State Seed Laboratory to make sure that it is free from noxious weed seed. Elevators, seed houses, and grain exchanges in this and surrounding States have been informed of the provisions of this Weed Law. Truckers bringing grain into the State are also notified of their responsibilities under the law.

Since much of the infestation was caused by threshing machines, stringent regulations on cleaning machines before moving to another farm is also a part of Nebraska's attempt to prevent, control, and eradicate bindweed.

The program tentatively outlined by the supervisors includes the establishment of demonstration plats the first year in conjunction with control methods which will completely eradicate all bindweed within 3 to 5 years.

Final Reports on Boulder Canyon Project

THERE are in the course of preparation in the office of the Chief Engineer of the Bureau of Reclamation, Denver, Colo., a series of final engineering and technical reports on the design and construction of the Boulder Canyon project, including the Boulder and Imperial Dams, power plants, All-American Canal, outlet and desilting works, and an account of the researches and experiments leading to the design and construction of these irrigation structures.

The series of illustrated reports is divided into seven parts with a total of more than 40 separate bulletins as follows:

- I. Introduction:
  1. General Description of Project.
  2. History of Project.
  3. Legal and Financial Problems.
- II. Hydrology:
  1. Stream Flow and Reservoir Operation.
  2. Lower Basin Utilization.
  3. Upper Basin Utilization.
- III. Preparatory Examinations and Construction:
  1. Geologic Investigations.
  2. Surveys and Preliminary Construction.
- IV. Design and Construction:
  1. General Features.
  2. Concrete Manufacture, Handling, and Control.
  3. Boulder Dam.
  4. Diversion Structures and Spillways.
  5. Penstocks and Outlet Pipes.
  6. Intake Towers and Outlet Works.
  7. Hydraulic Valves and Gates.
  8. Handling Facilities. (Cableway, cranes, and other permanent handling facilities).
  9. Power Plant Building.
  10. Generating, Transforming, and Switching Equipment.
  11. Turbines, Governors, and Mechanical Auxiliaries.
  12. Control, Communication, and Electrical Auxiliaries.
  13. Imperial Dam and Desilting Works.
  14. All-American Canal and Canal Structures.
- V. Technical Investigations:
  1. Trial Method of Analyzing Concrete Dams.
  2. Model Tests of Boulder Dam.
  3. Slab Analogy Experiments.
  4. Stress Studies for Boulder Dam.
  5. Penstock Analysis and Stiffener Design.
  6. Model Tests of Arch and Cantilever Elements.
  7. Research Measurements at Dam.
- VI. Hydraulic Investigations:
  1. Model Studies of Spillways.
  2. Model Studies of Penstock and Outlet Works.

3. Studies of Crests for Overfall Dams.
4. Model Studies of Imperial Dam and Desilting Works.
5. Model Studies of All-American Canal Structures.
6. Silt Movement in Colorado River.

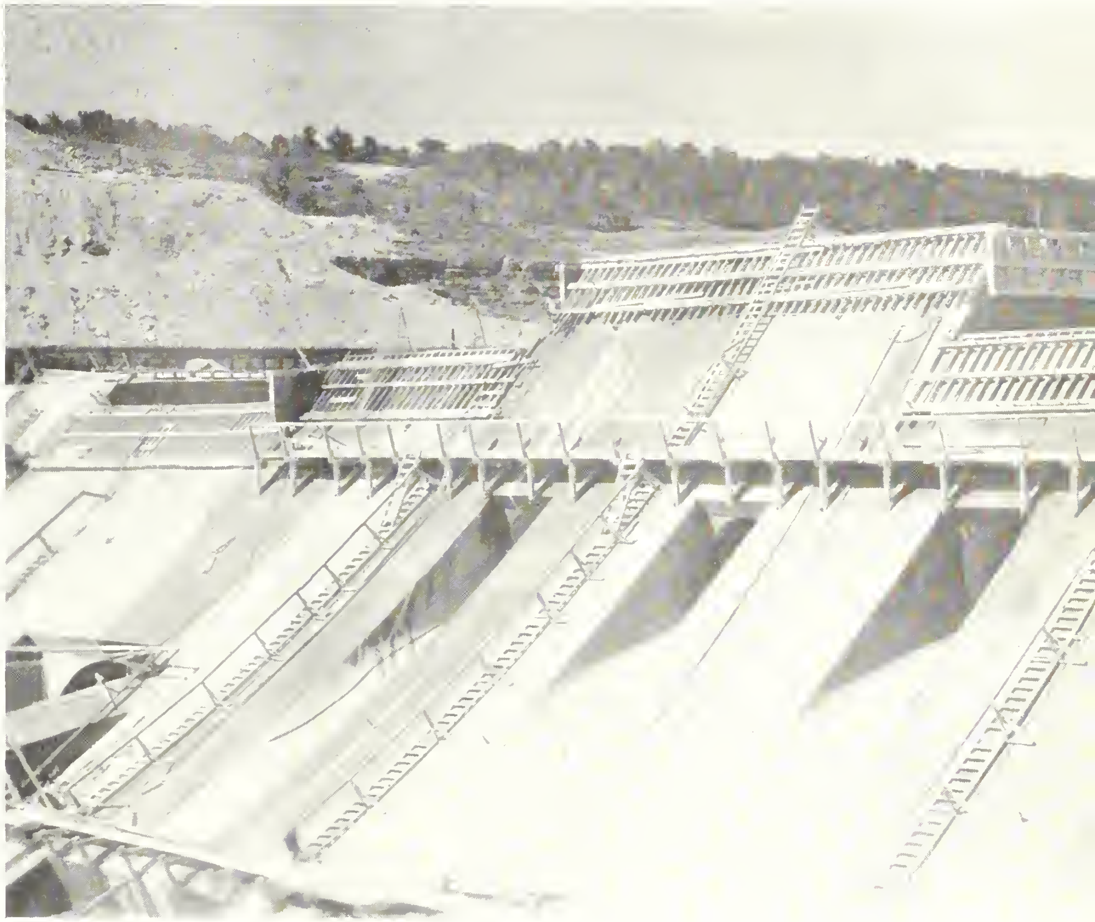
VII. Cement and Concrete Investigations:
1. Thermal Properties of Concrete.
2. Investigation of Portland Cements.
3. Cooling of Concrete Dams.
4. Mass Concrete Investigations.
5. Contraction Joint Grouting.
6. Volume Changes in Mass Concrete.

These final reports are now being issued, and two of the bulletins have already been received as follows: Model studies of Spillways, illus., 190 pages, price $1 paper, and $1.50 cloth bound. Model studies of Penstock and Outlet Works, illus., price $1 paper, and $1.50 cloth bound.

Copies of the illustrated reports as issued can be purchased from the Bureau of Reclamation at either the Washington or Denver office.

Washington Office Mail Bag

A RECENT count of the amount of mail received and dispatched by the Washington Office of the Bureau of Reclamation during a representative 10-day period shows the following interesting figures: 4,569 pieces of mail received, 865 being the greatest number received during any one day; 2,255 letters prepared and mailed; and 2,668 pieces of second-class mail, including specifications, literature, and maps, dispatched.



Downstream face of Parker Dam from California side of river; powerhouse substructure, initial construction, is complete in left foreground

NOTES FOR CONTRACTORS

Specification No.	Project	Bids opened	Work or material	Low bidder		Bid	Terms	Contract awarded
				Name	Address			
771	Central Valley, Calif.	1938 Apr. 11	Diversion tunnel at Shasta Dam and temporary relocatiou of Southern Pacific R. R.	Colonial Construction Co.	Spokane, Wash.	$426,475.00		1939 May 9
1050-D	Salt River, Ariz.	Apr. 4	Structural steel and stairways for installation in Bartlett Dam.	Reliance Steel Products Co.	McKeesport, Pa.	6,120.00	F. o. b. McKeesport. Discount 1 percent.	Apr. 18
1053-D	Kendrick, Wyo.	do.	30,000 barrels of sulfate-resisting portland cement.	United States Portland Cement Co.	Denver, Colo.	67,500.00	F. o. b. Boettcher, Colo. Discount and sacks allowance 50 cents.	Apr. 72
1055-D	do.	Apr. 18	2 102-inch steel bulkheads for penstocks at Seminoe power plant.	California Steel Products Co.	San Francisco, Calif.	1,374.00	F. o. b. San Francisco.	Apr. 2
1056-D	Rio Grande, N. Mex.	Apr. 20	1 double-drum tamping roller and 1 single-drum tamping roller for Caballo Dam.	Emsco Derrick & Equipment Co.	Los Angeles, Calif.	3,939.61	F. o. b. Los Angeles.	Apr. 26
1057-D	Truckee Storage, Nev.-Calif.	Apr. 25	2 4- by 4-foot high-pressure gate assemblies for Boca Dam.	Commercial Iron Works.	Portland, Oreg.	9,945.00	F. o. b. Portland. Discount ½ percent.	Apr. 30
28,034-A	Buffalo Rapids, Mont.	Apr. 1	5,000 barrels of standard portland cement in cloth sacks.	Three Forks Portland Cement Co..	Denver, Colo.	12,500.00	F. o. b. Trident, Mont. Discount and sacks allowance 50 cents.	Apr. 27
48,129-A	Shoshone-Heart Mountain, Wyo.	Apr. 8	Steel reinforcement bars (991,616 pounds).	Laclede Steel Co.	St. Louis, Mo.	[1] 3,335.27	F. o. b. Corbett, Wyo. Discount ½ percent.	Apr. 18
				Carnegie-Illinois Steel Corporation.	Denver, Colo.	[2] 23,446.37	F. o. b. Corbett, Wyo. Discouut ½ perceut b. p. v.	Apr. 27
A-38,041-A	Columbia Basiu, Wash.	Apr. 27	Couplings for 1-inch o. d. tubing	M. L. Foss, Inc.	Denver, Colo.	[3] 14,316.58	F. o. b. Odair, Wash. Discount 5 percent.	May 19
1059-D	Sun River, Mont.	May 4	Earthwork and structures for open drains, Greenfields division.	Jack Boyne	Council Bluffs, Iowa.	25,757.40		May 21
1058-D	Kendrick, Wyo.	Apr. 26	Pumping units and waterjet eductors for Seminoe power plant.	Hendric & Botthoff Manufacturing Co.	Denver, Colo.	[1] 385.45	F. o. b. Pomona, Calif. Discount 3 percent.	May 13
				Frederick Iron & Steel Co.	Frederick, Md.	[2] 206.00	F. o. b. Frederick	May 16
				Woodin & Little, Inc.	San Francisco, Calif.	[4] 445.85	F. o. b. Rockford, Ill.	May 17
				Schutte & Koerting Co.	Philadelphia, Pa.	[5] 636.00	F. o. b. Philadelphia	May 16
1054-D	do.	Apr. 21	Carrier-current telephone apparatus for Guernsey power plant.	General Electric Co.	Schenectady, N. Y.	[6] 5,015.00	F. o. b. Guernsey [1] and Casper.[2]	May 12
1052-D	Pine River, Colo.	May 11	Sale of timber on Vallecito res. site	Weston Lumber Co.	Denver, Colo.	9,500.00		May 17

[1] Schedule 1. [2] Schedule 2. [3] Schedules 1 to 4, inclusive. [4] Schedule 3. [5] Schedule 4. [6] Schedules 1 and 2.

Personnel Administrators Announced

• *Director of Personnel*

Mrs. J. ATWOOD MAULDING of Bucksport, Maine, entered the service of the Department of the Interior 20 years ago in the capacity of stenographer in the Appointment Division. Through application to duty and the display of administrative ability, and the endearing of herself to her associates, she passed progressively to assistant chief of division and then chief.

As unemployment increased in the United States, and Congress appropriated emergency funds to deal with this and the depression, a huge public works program was inaugurated. Mrs. Maulding was immediately drafted as assistant to Mr. E. K. Burlew, then Administrative Assistant to the Secretary of the Interior and Budget Officer.

A staff of employees had to be immediately put to work in the Interior Department and the Public Works Administration, and days and nights were filled with activity to accomplish this task well, in the shortest time possible.

Mrs. Maulding is receiving the felicitations of her associates and friends as they are happy in her selection now to take hold of the controls in the capacity of Director of Personnel of the Department of the Interior. This is estimated at present at 41,000 persons and some idea of the task she has in charge may be formed from the fact that personnel changes of all kinds average approximately 2,750 a month. This represents actual case work, while interviews, conferences, and committee work require her personal attention.

Mrs. Maulding reports to the First Assistant Secretary of the Interior, to which position Mr. E. K. Burlew has just been appointed by the President and confirmed by the Senate.

Mrs. Maulding is particularly charged with the supervision of employment and personnel administration in the Department, such supervision to include the Puerto Rico Reconstruction Administration.

• *Executive Assistant Public Works Administration*

EDGAR F. PURYEAR of Roswell, N. Mex., Director of Employment of the Public Works Administration, was appointed as Executive Assistant to the Administrator of Public Works and under the direction of the Secretary of the Interior has supervision over employment and personnel administration in P. W. A., such supervision to include the National Resources Committee.

The present personnel of P. W. A. is 4,000. In the peak of operations the personnel was approximately 10,000. Mr. Puryear served with distinction during the period of recruiting this large staff to handle activities created almost overnight by emergency appropriations and brings a wealth of ability to his new position as Executive Assistant.

• *Chief, Division of Appointments*

GUY W. NUMBERS' appointment as Chief of the Division of Appointments, succeeding Mrs. Maulding, is of particular gratification to the Bureau of Reclamation as he is one "of our own." Mr. Numbers who is from York, Pa., left the Bureau of Reclamation early in 1930, after serving as the Bureau's Appointment Clerk, and later as accountant, and was recognized by further promotion to the position of Assistant Chief of the Division of Appointments of the Department. Mr. Numbers' combined service in the Bureau of Reclamation and the Office of the Secretary totals 30 years.

In his latest promotion as Chief of the Division he will have immediate charge of the Division of Appointments under the general supervision of the Director of Personnel. Every status change of an employee of this Department must be handled in this Division. Mr. Numbers is able, has a large capacity for hard work, and the happy faculty of making friends as he goes.

• *Chief, Civilian Conservation Corps Personnel Unit*

STUART C. BROWNE of Chicago, Ill., for a number of years in the Office of the Secretary, has been promoted as Chief of the Civilian Conservation Corps personnel unit and will be in immediate charge of that unit under the general supervision of the Director of Personnel.

The task of handling personnel changes under C. C. C. is no small one and Mr. Browne brings to his new position an excellent knowledge of the work.

The various bureaus of the Department of the Interior dealing with personnel changes through the Office of the Secretary appreciate the fact that the handling of personnel is in charge of experts in their respective fields, as personnel administration is a very exacting task requiring a volume of knowledge of detail. The smooth operation of each project depends entirely on its staffing and in this the finest cooperation is extended through the supervisory office in the Office of the Secretary.—M. A. S.

Mrs. J. ATWOOD MAULDING
Director of Personnel
Department of the Interior

EDGAR F. PURYEAR
Executive Assistant to the
Administrator of Public Works

STUART C. BROWNE
Chief, Civilian Conservation Corps
Personnel Unit
Department of the Interior

GUY W. NUMBERS
Chief, Division of Appointments
Department of the Interior

Reclamation Organization Activities

Assistant Commissioner Williams in West

ROY B. WILLIAMS, Assistant Commissioner of Reclamation, left Washington June 1 for a 6 weeks' tour of the Federal Reclamation projects, his first stop being at the Denver Office of the Bureau.

Mr. Williams toured with Chief Engineer Walter over a number of the northwestern projects. At Yellowstone Park on June 23 he substituted for Commissioner Page, delivering an address at the annual meeting of the American Farm Bureau.

After visiting the Oregon, Idaho, and California projects, Mr. Williams will return to Washington via Boulder Dam about the middle of July.

George O. Sanford Addresses Engineer's Club

GEORGE O. SANFORD, General Supervisor of Operation and Maintenance with headquarters in Washington, addressed the Engineers' Club of Trenton, N. J., on the evening of May 12, his subject being Grand Coulee Dam.

W. R. Nelson Gives Illustrated Lecture

WESLEY R. NELSON, Chief of the Engineering Division, substituting for Commissioner Page, addressed the Erie section of the American Institute of Electrical Engineers at Erie, Pa., May 17, on the subject of Grand Coulee Dam. The lecture was illustrated with lantern slides and was followed by the showing of a two-reel silent film on Grand Coulee Dam.

L. H. Mitchell in Field

L. H. MITCHELL, Field Supervisor of the Operation and Maintenance Division, left Washington April 25 to take up work in the field. Most of his time will be spent on the northern and central projects, where he will continue his educational work in bringing about more economical use of water, soil conservation, and weed eradication.

Mr. Mitchell will spend several days on the Kittitas Division of the Yakima project where he will consider the problems that have arisen in connection with soil erosion. From Yakima he expects to visit the Frenchtown project in Montana and advise the water users who are starting their farming operations under irrigation for the first time.

Arrowrock Dam, Boise Project, Idaho, showing newly surfaced face

L. E. Foster Gets Additional Appointment

L. E. FOSTER, superintendent of the Carlsbad project, N. Mex., has been appointed by the Secretary of the Interior as a member of the Interdepartmental Upper Rio Grande Board. He attended an organizational session in Washington, D. C., extending from April 27 to 30, inclusive, at which time the following organization was set up:

Walter V. Woehlke (Interior), chairman.

Hugh G. Calkins, Soil Conservation Service (Agriculture), vice chairman.

John A. Adams, Forest Service (Agriculture), secretary.

L. E. Foster, Bureau of Reclamation (Interior).

A. D. Ryan, Division of Grazing (Interior).

Dr. Sophie D. Aberle, Office of Indian Affairs (Interior).

Mason Barr, Farm Security Administration (Agriculture).

M. M. Kelso, Bureau of Agricultural Economics (Agriculture).

The board adjourned April 30, subject to call of the chairman at some point in the area to be dealt with, very likely Albuquerque.

The board is engaged in coordinating the activities of the various organizations with representation on the board to bring about land use adjustments in the upper Rio Grande watershed, to stabilize the watershed and improve the condition of the rural subsistence population.

Personnel Changes

THE following recent personnel changes in the Bureau of Reclamation have been authorized by the Secretary of the Interior:

Appointments

Denver Office:

Charles H. Inman, Jr., junior engineer, by transfer from junior civil engineer, War Department, vice Dana D. Sherrill, resigned.

Donald S. Rand, junior engineer, vice Richard L. Mattes, reassigned.

Marion J. Smith, junior engineer.

M. Jack Bernstein, junior engineer, by transfer from War Department, United States Engineers' Office, Rock Island, Ill.

Cyril J. Miller, junior engineer, vice Donald G. Worth, reassigned. Mr. Miller's appointment was accomplished through reinstatement.

Pine River:

James D. Seery, assistant engineer, by transfer from assistant engineer, Indian Irrigation Service, Window Rock, Ariz.

Transfers

To Denver Office:

Charles R. Double, junior engineer, from Boulder Canyon project.

To Deschutes:

Chester C. Fisher, engineer, from Grand Ronde Investigations, La Grande, Oreg.

To Columbia Basin:

Herman F. Bahmeier, engineer, from Upper Snake River project, Ashton, Idaho.

Separations

Washington Office:

Mrs. Stella H. Moss, senior stenographer, to reside in Boston, Mass.

Denver Office:

B. Joseph Tofani, junior engineer, to accept employment with the Pennsylvania Power & Water Resources Commission, Harrisburg, Pa.

Yuma:

Rudolph C. E. Weber, superintendent, Yuma Ariz., to take care of private interests.

Salt River:

Herman J. Shafer, junior engineer, Salt River, work completed.

Yakima:

Garland S. Tinsley, junior engineer, Yakima, Wash., to accept employment with a private concern.

New Home of Electrification Association

THE Sun River Electrification Association now has its offices at Fairfield, Mont., headquarters of the Sun River project.

Yakima Sugar Company to Expand

THE Utah-Idaho Sugar Co. has announced plans to add $100,000 worth of equipment to its Toppenish (Yakima project) plant and $14,000 worth of equipment in the field. The improvements will be made in time to handle the 1938 crop.

Milk River Community Organization

A VERY noticeable community spirit is being developed among the new settlers of the South Wagner resettlement area on the Milk River project. An excellent community hall has been provided which serves the purpose of a school and community center. Community organizations of various types have been perfected and frequent gatherings are held which are attended by all residents.

Report on Rio Grande Investigation

FOLLOWING the signing of a compact by Colorado, New Mexico, and Texas, which allocates the waters of the Rio Grande above Fort Quitman, the National Resources Committee has made public the report on the Rio Grande Investigation which served as a basis for the compact.

Since the compact is based on engineering facts no longer in dispute and appears satisfactory to the parties involved, favorable action is expected by the State legislatures and by Congress, thus ending a controversy of long standing.

The joint investigation was undertaken at the request of Colorado, New Mexico, and Texas, with the National Resources Committee serving as a channel for the organization of studies and surveys by appropriate Federal and State agencies. The States engaged in the controversy joined with one another and with the Federal Government in assembling the factual data essential to an equitable allocation of interstate waters.

Three States and seven Federal agencies participated in the work. Cooperating Federal agencies were the Bureau of Agricultural Engineering, the Bureau of Reclamation, Geological Survey, Indian Office, Soil Conservation Service, Bureau of Plant Industry, and the Resettlement Administration.

The solution of the problems of the Upper Rio Grande, says the report, "requires a comprehensive and adequate basis of fundamental facts—facts which definitely establish the available and potential water supplies, the present uses of water, and the requirements for it. With these facts in hand, reliable estimates should be possible of future changes in the water supply due to such developments as storage in Colorado, the proposed transmountain diversions from the basin of the San Juan, and the ultimate irrigation in the Middle Rio Grande conservancy district.

"This report presents a basis of facts which it is hoped may prove adequate for the solution of these problems, to the end that the water resources of the Upper Rio Grande Basin may be put to maximum beneficial use and that all conflict of Federal, State, and local interests may be permanently dispelled."

The hopes that were entertained with respect to the joint investigation have already been realized in part with the signing of the compact. It should also promote the formulation of a plan and program for the orderly development of the water resources of the region in accordance with the compact.

The report is in two volumes; one containing the text and the other supporting data.

Intake pumping plant built by the Metropolitan Water District of Southern California to lift 1,500 cubic feet of water per second 290 feet above Parker Reservoir, into Colorado River tunnel and Gene Wash Reservoir of the Colorado River Aqueduct system. Present installation consists of three pumping units designed to handle one-third the ultimate capacity, or 500 cubic feet per second

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ASHURST, HON. HENRY F.
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BARTLETT DAM
Verde River flood, illus., C. S. Jarvis, Engineering News-Record, May 5, 1938, Vol. 120, No. 18, p. 641.

BENNETT, J. GARDNER
The Story of Engineering, University of Knowledge, Chicago, Ill., 1938, 384 pp. (Boulder Dam, illus., on pages 42, 64, 288, and 290)

BENSON, PROF. H. K.
Potential Chemical Industries in the Columbia River Basin, Washington, University of Washington, 142 pp., and 24 figures.

BOULDER DAM POWER
Boulder Dam in operation, illus., Power Plant Engineering, February 1938, Vol. 42, No. 2, p. 123.

DAMS AND CONTROL WORKS
Dams and Control Works, illus., 2d Edition, Russell Kimball, Percy I. Taylor, and William E. Warne, Editors, February 1938, 261 pp., Price $1.

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The Canyon from above, illus., New York Times, Sunday, April 17, 1938, Travel Section, p. 6.

HILL, HON. KNUTE
Reclamation in the Far West, from the Christian Science Monitor, Cong. Record, May 3, 1938, Vol. 83, No. 90, p. 8226.

KINGMAN, ARIZONA, POWER
Kingman, Arizona, to be served with power from Boulder Dam, Southwest Builder and Contractor, April 8, 1938, Vol. 91, No. 14, p. 100.

KINZIE, P. A.
The outlet works and valves at Boulder Dam, illus., and inset, Engineering, London, January 7, 1938, Vol. 145, No. 3756, pp. 5–7 and inset. (Began January 1, 1937.)

Fifth article of gate series, 13th of series on Boulder Dam mechanical series, illus., Engineering, London, January 14, 1938, Vol. 145, No. 3757, pp. 27–30, 40, and inset.

LAKE MEAD
Passage of turbid water through Lake Mead, R. E. Redden, and R. A. Hill, Proc. A. S. C. E., April 1938, Vol. 64, No. 4, pp. 781–791.

LOS ANGELES AQUEDUCT
Distribution of 1,000 M. G. D., Metropolitan Water District of Southern California, illus. and map, R. B. Diemer, Water Works Engineering, April 13, 1938, Vol. 91, No. 8, pp. 468–473.

MEXICAN IRRIGATION DAMS
Three large dams in Mexico, illus., J. J. Ortega, Compressed Air Magazine, April 1938, Vol. 43, No. 4, pp. 5581–5584 (El Palmito, La Angostura and El Azucar dams).

MURDOCK, HON. JOHN R.
Brief tribute to the Bureau of Reclamation, Cong. Record, April 7, 1938, Vol. 83, No. 72, p. 6569.

NORTH PLATTE WATERS
Federal Government moves to protect millions spent on Reclamation projects, Southwest Builder and Contractor, April 22, 1938, Vol. 91, No. 16, page 92.

PAGE, JOHN C.
Elements of cost of power, Proc. A. S. C. E., April 1938, Vol. 64, No. 4, pp. 638–646.

Engineer plus has opportunity to do great service for the country (address before Nebraska Engineering Society), Southwest Builder and Contractor, April 22, 1938, Vol. 91, No. 16, pp. 11–12 and 14.

PRICE, F. E.
Sprinkler irrigation in the humid sections of Oregon, illus., Agricultural Engineering, April 1938, Vol. 19, No. 4, pp. 161–162.

RECLAMATION ERA, THE
Bound copies of Vol. 27 of Reclamation Era for 1937, consisting of 292 pages and illustrations with index are available, Price $1.

SEMINOE DAM
Wire rope is used widely at Seminoe Dam, illus., by J. H. D. Blanke, The International Engineer, April 1938, Vol. 73, No. 4, pp. 109–112.

SHASTA DAM
Bids for constructing Shasta Dam advertised to be opened June 1, Southwest Builder and Contractor, April 8, 1938, Vol. 91, No. 14, page 11.

Bids called for Shasta Dam—Central Valley project, illus., Western Construction News, April 1938, Vol. 13, No. 4, pp. 129–132.

Construction features of Shasta dam and power plant disclosed, illus., Southwest Builder and Contractor, April 29, 1938, Vol. 91, No. 17, pp. 12–14.

Bigger than Boulder, illus., Engineering News-Record, May 5, 1938, Vol. 120, No 18, pp. 647–651.

SPILLWAYS, MODEL STUDIES OF
Boulder Canyon project final reports prepared in the office of Chief Engineer, Denver, Colorado, Part VI, Hydraulic Investigations, Bulletin No. 1. Model studies of spillways, illus., 190 pages, 1938. Price: paper $1, cloth bound $1.50.

TAYLOR, HON. EDWARD T.
Interstate Compacts on Interstate Streams, Decision of the United States Supreme Court regarding Interstate Compacts, Cong. Record, May 2, 1938, Vol. 83, No. 89, pp. 8075–8078.

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Grassy Lake Dam and Cross Cut Canal, illus., I. D. Jerman and J. R. Sutherland, Western Construction News, April 1938, Vol. 13, No. 4, pp. 159–162.

WEYMOUTH, F. E.
Aqueduct source, why the Colorado River was selected as the source of supply. Aqueduct News, April 25, 1938, Vol. 5, No. 8, p. 6.

WILLAMETTE RIVER
Willamette River program approved by United States Engineers, map and table, Western Construction News, April 1938, Vol. 13, No. 4, pp. 146–149.

Power Development in April Federal Reclamation Projects [1]

Project	Output (Kilowatt-hours)
Arizona, Salt River	39, 062, 920
Arizona-Nevada, Boulder Canyon	124, 789, 000
Colorado, Grand Valley	448, 470
Idaho:	
Boise	6, 407, 939
Minidoka	6, 298, 000
Nebraska-Wyoming, North Platte	1, 893, 720
Nevada, Newlands	260, 690
Utah, Strawberry	241, 372
Washington, Yakima	2, 024, 000
Wyoming:	
Riverton	1, 151, 787
Shoshone	732, 700
Total	183, 310, 598

[1] The Siphon Drop Power Plant, Yuma project, was not operated in April, as work in connection with alterations to the forebay and spillway made this impracticable.

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ADMINISTRATIVE ORGANIZATION OF THE BUREAU OF RECLAMATION

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Projects under construction or operated in whole or in part by the Bureau of Reclamation

Project	Office	Official in charge		Chief clerk	District counsel	
		Name	Title		Name	Address
All-American Canal [1]	Yuma, Ariz	Leo J. Foster	Constr. engr	J. C. Thraikill	R. J. Coffey	Los Angeles, Calif.
Belle Fourche	Newell, S. Dak	F. C. Youngblutt	Superintendent	J. P. Siebeneicher	W. J. Burke	Billings, Mont.
Boise	Boise, Idaho	R. J. Newell	Constr. engr	Robert B. Smith	B. E. Stoutemyer	Portland, Oreg.
Boulder Dam and power plant [1]	Boulder City, Nev	Irving C. Harris	Constr. engr.[2]	Gail H. Baird	R. J. Coffey	Los Angeles, Calif.
Buffalo Rapids	Glendive, Mont	Paul A. Jones	Constr. engr	Edwin M Bean	W. J. Burke	Billings, Mont.
Carlsbad	Carlsbad, N. Mex	L. E. Foster	Superintendent	E. W. Shepard	H. J. S. Devries	El Paso, Tex.
Central Valley	Sacramento, Calif	W. R. Young	Constr. engr	E. R Mills	R. J. Coffey	Los Angeles, Calif.
Colorado-Big Thompson	Denver, Colo			C. M. Voyen	J R. Alexander	Salt Lake City, Utah.
Colorado River	Austin, Tex	Ernest A. Moritz	Constr. engr	William F Sha	H. J. S Devries	El Paso, Tex
Columbia Basin	Coulee Dam, Wash	F. A. Banks	Constr. engr	C. B. Funk	B. E. Stoutemyer	Portland, Oreg
Deschutes	Bend, Oreg	C. C. Fisher	Engineer		B. E. Stoutemyer	Portland, Oreg.
Fruit Grower's Dam	Montrose, Colo	Clyde H. Spencer	Constr. engr	Ewalt P. Anderson	J. R. Alexander	Salt Lake City, Utah.
Gila	Yuma, Ariz	Leo J. Foster	Constr. engr		R J. Coffey	Los Angeles, Calif.
Grand Valley	Grand Junction, Colo	W. J. Chiesman	Superintendent	Emil T. Ficener	J. R. Alexander	Salt Lake City, Utah.
Humboldt	Lovelock, Nev	Stanley R. Marean	Resident engr.[2]	George B. Snow	J. R. Alexander	Salt Lake City, Utah.
Kendrick	Casper, Wyo	H. W. Bashore	Constr. engr	George W. Lyle	W. J. Burke	Billings, Mont.
Klamath	Klamath Falls, Oreg	B. E. Hayden	Superintendent	W. I. Tingley	B. E. Stoutemyer	Portland, Oreg.
Milk River	Malta, Mont	H. H. Johnson	Superintendent	E. E. Chabot	W. J. Burke	Billings, Mont.
Fresno Dam	Havre, Mont	H V. Hubbell	Constr. engr	E. E. Chabot	W. J. Burke	Billings, Mont.
Minidoka	Burley, Idaho	Dana Templin	Superintendent	G. C Patterson	B. E. Stoutemyer	Portland, Oreg.
Moon Lake	Duchesne, Utah	E. J. Westerhouse	Constr. engr	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
North Platte	Guernsey, Wyo	C. F. Gleason	Supt. of power	A. T. Stimpfig	W. J. Burke	Billings, Mont.
Orland	Orland, Calif	D. L. Carmody	Superintendent	W. D. Funk	R. J. Coffey	Los Angeles, Calif.
Owyhee	Boise, Idaho	R. J. Newell	Constr. engr	Robert B. Smith	B. E. Stoutemyer	Portland, Oreg.
Parker Dam	Parker Dam, Calif	Howard P. Bunger	Constr engr		R. J. Coffey	Los Angeles, Calif.
Pine River	Durango, Colo	Charles A. Burns	Constr engr	John S. Martin	J R. Alexander	Salt Lake City, Utah.
Provo River	Provo, Utah	E O. Larson	Engineer	Francis J. Farrell	J R. Alexander	Salt Lake City, Utah.
Rio Grande	El Paso, Tex	L. R. Fiock	Superintendent	H. H. Berryhill	H. J. S. Devries	El Paso, Tex.
Caballo Dam	Caballo, N. Mex	S. F. Crecelius	Constr engr	H. H. Berryhill	H. J. S Devries	El Paso, Tex
Riverton	Riverton, Wyo	H. D. Comstock	Superintendent	C B. Wentzel	W. J. Burke	Billings, Mont.
Bull Lake Dam	Riverton, Wyo	Arthur P. Smyth	Resident engr	Chas. B. Wentzel	W. J. Burke	Billings, Mont
Salt River	Phoenix, Ariz	E. C. Koppen	Constr engr	Edgar A. Peek	R. J. Coffey	Los Angeles, Calif.
Sanpete	Provo, Utah	E. O. Larson	Engineer	Francis J. Farrell	J R. Alexander	Salt Lake City, Utah.
Shoshone	Powell, Wyo	L. J. Windle	Superintendent [2]	L. J. Windle [2]	W. J. Burke	Billings, Mont.
Heart Mountain division	Cody, Wyo	Walter F. Kemp	Constr engr	L. J. Windle [2]	W. J. Burke	Billings, Mont.
Sun River, Greenfields division	Fairfield, Mont	A. W. Walker	Superintendent		W. J. Burke	Billings, Mont.
Truckee River Storage	Reno, Nev	Charles S. Hale	Constr. engr	George B. Snow	J. R Alexander	Salt Lake City, Utah.
Umatilla (McKay Dam)	Pendleton, Oreg	C. L. Tice	Reservoir supt		B. E. Stoutemyer	Portland, Oreg.
Uncompahgre Repairs to canals	Montrose Colo	Denton J. Paul	Constr. engr [2]		J. R. Alexander	Salt Lake City, Utah.
Upper Snake River Storage [3]	Ashton, Idaho	H. A. Parker	Constr. engr	Emmanuel V. Hillins	B. E. Stoutemyer	Portland, Oreg.
Vale	Vale, Oreg	C. C. Ketchum	Superintendent		B. E. Stoutemyer	Portland, Oreg.
Yakima	Yakima, Wash	J. S. Moore	Superintendent	Philo M. Wheeler	B. E. Stoutemyer	Portland, Oreg.
Roza division	Yakima, Wash	Charles E. Crownover	Constr engr	Alex S. Harker	B. E. Stoutemyer	Portland, Oreg.
Yuma	Yuma, Ariz	C. B. Elliott	Superintendent	Noble O. Anderson	R. J. Coffey	Los Angeles, Calif.

[1] Boulder Canyon. [2] Acting. [3] Island Park and Grassy Lake Dams.

Projects or divisions of projects of Bureau of Reclamation operated by water users

Project	Organization	Office	Operating official		Secretary	
			Name	Title	Name	Address
Baker (Thief Valley division [1]	Lower Powder River irrigation district	Baker, Oreg	A. J Ritter	President	F. A. Phillips	Keating.
Bitter Root [4]	Bitter Root irrigation district	Hamilton Mont	N. W. Blindauer	Manager	Elsie H. Wagner	Hamilton.
Boise [1]	Board of Control	Boise, Idaho	Wm. H. Tuller	Project manager	L. P. Jensen	Boise.
Boise [1]	Black Canyon irrigation district	Notus, Idaho	W. H. Jordan	Superintendent	L. M. Watson	Caldwell.
Frenchtown	Frenchtown irrigation district	Frenchtown, Mont			Ralph P. Scheffer	Huson.
Grand Valley, Orchard Mesa [3]	Orchard Mesa irrigation district	Grand Jctn., Colo	C. W. Tharp	Superintendent	C. J. McCormich	Grand Jctn.
Huntley [4]	Huntley irrigation district	Ballantine, Mont	E. E. Lewis	Manager	H. S. Elliott	Ballantine.
Hyrum [3]	South Cache W. U. A	Hyrum, Utah	B. L. Mendenhall	Superintendent	Harry C. Parker	Logan.
Klamath, Langell Valley [1]	Langell Valley irrigation district	Bonanza, Oreg	Chas. A. Revell	Manager	Chas. A Revell	Bonanza.
Klamath, Horsefly [1]	Horsefly irrigation district	Bonanza, Oreg	Henry Schmor, Jr	President	Dorothy Eyers	Bonanza.
Lower Yellowstone [4]	Board of Control	Sidney, Mont	Axel Persson	Manager	Axel Persson	Sidney.
Milk River: Chinook division [4]	Alfalfa Valley irrigation district	Chinook, Mont	A. L. Benton	President	R. H. Clarkson	Chinook.
Minidoka: Gravity [1]	Minidoka irrigation district	Rupert, Idaho	Frank A. Ballard	Manager	O. W. Paul	Rupert.
Pumping [1]	Burley irrigation district	Burley, Idaho	Hugh L. Crawford	Manager	Frank O. Redfield	Burley.
Gooding [1]	Amer. Falls Reserv. Dist. No. 2	Gooding, Idaho	S. T. Baer	Manager	Ida M. Johnson	Gooding.
Newlands [3]	Truckee-Carson irrigation district	Fallon, Nev	W. H. Wallace	Manager	H. W. Emery	Fallon.
North Platte: Interstate division [4]	Pathfinder irrigation district	Mitchell, Nebr	T. W. Parry	Manager	Flora K. Schroeder	Mitchell.
Fort Laramie division [4]	Gering-Fort Laramie irrigation district	Gering, Nebr	W. O. Fleenor	Superintendent	C. G. Klingman	Gering.
Fort Laramie division [4]	Goshen irrigation district	Torrington, Wyo	Bert L. Adams	Superintendent	Mary E. Harrach	Torrington.
Northport division [4]	Northport irrigation district	Northport, Nebr	Mark Iddings	Superintendent	Mabel J. Thompson	Bridgeport.
Ogden River	Ogden River W. U. A	Ogden, Utah	Ora Bundy	President	Wm. P. Stephens	Ogden, Utah.
Okanogan [1]	Okanogan irrigation district	Okanogan, Wash	Nelson D. Thorp	Manager	Nelson D. Thorp	Okanogan.
Salt Lake Basin (Echo Res.) [3]	Weber River Water Users' Assn	Ogden, Utah	D. D. Harris	Manager	D. D. Harris	Layton.
Salt River [2]	Salt River Valley W. U. A	Phoenix, Ariz	H. J. Lawson	Superintendent	F. C. Henshaw	Phoenix.
Shoshone: Garland division [4]	Shoshone irrigation district	Powell, Wyo.	M. P. McLaughlin	Irri. superintendent	Geo. W. Atkins	Powell.
Frannie division [4]	Deaver irrigation district	Deaver, Wyo	Floyd Lucas	Superintendent	Lee N. Richards	Deaver.
Strawberry Valley [3]	Strawberry Water Users' Assn	Payson, Utah	S. W. Grotegut	Manager	E. G. Breeze	Payson.
Sun River: Fort Shaw division [4]	Fort Shaw irrigation district	Fort Shaw, Mont	C. L. Bailey	Manager	E. J. Gregory	Fort Shaw.
Greenfields division [4]	Greenfields irrigation district	Fairfield, Mont	A. W. Walker	Manager	H. P. Wangen	Fairfield.
Umatilla: East division [1]	Hermiston irrigation district	Hermiston, Oreg	E. D. Martin	Manager	Enos D. Martin	Hermiston.
West division [1]	West Extension irrigation district	Irrigon, Oreg	A. C. Houghton	Manager	A. C. Houghton	Irrigon.
Uncompahgre [3]	Uncompahgre Valley W. U. A	Montrose, Colo	Jesse R. Tompson	Acting superintendent	J. Frank Anderson	Montrose.
Yakima, Kittitas division [1]	Kittitas reclamation district	Ellensburg, Wash	V. W. Russell	Manager	G. L. Sterling	Ellensburg.

[1] B. E. Stoutemyer, district counsel, Portland, Oreg.
[2] R. J. Coffey, district counsel, Los Angeles, Calif.
[3] J. R. Alexander, district counsel, Salt Lake City, Utah.
[4] W. J. Burke, district counsel, Billings, Mont.

Important investigations in progress

Project	Office	In charge of—	Title
Colorado River Basin, sec. 15	Denver, Colo	P. J. Preston	Senior engineer.
Boise-Weiser-Payette	Boise, Idaho	Lester C. Walker	Engineer.
Cabinet Gorge	Clarks Fork, Idaho	Wm. G. Sloan	Engineer.
Kenton	Denver, Colo	A. N. Thompson	Engineer.
Kings River-Pine Flat	Fresno, Calif	John R. Iakisch	Constr. engineer.
Western Slope (Colo.)	Denver, Colo	Frank C. Merriell	Engineer.
Black Hills	Denver, Colo	R. E. Kennedy	Assistant engineer.
Eastern Slope (Colo.)	Denver, Colo	A. N. Thompson	Engineer.
Salt Lake Basin	Provo, Utah	E. O. Larson	Engineer.
Marias	Shelby, Mont	Fred H. Nichols	Associate engineer.
Green River-Bear River	Denver, Colo		

Issued monthly by the Bureau of Reclamation, Department of the Interior, as approved by the Director of the Budget. SALLIE A. B. COE, *Editor*.

DIVERSIFIED FARMING ROUNDS OUT AGRICULTURAL
PROGRAM ON FEDERAL RECLAMATION PROJECTS

THE RECLAMATION ERA

JULY 1938

SHASTA DAM SITE, CENTRAL VALLEY PROJECT, CALIFORNIA

SHASTA DAM CONTRACT AWARDED

ON JUNE 1, 1938, at Sacramento, Calif., bids were opened under Specifications No. 780, for the construction of the Shasta Dam and power plant on the Sacramento River, Central Valley project, California. Only two bids were received. The low bidder, to whom the award was made on July 2, is a syndicate of 12 construction firms. It bid in the name of Pacific Constructors, Inc., of Los Angeles, Calif. The company is composed of Griffith Co. of Los Angeles; the Metropolitan Construction Co. of Los Angeles; Lawler & Maguire of Butte, Mont.; The Arundel Corporation of Baltimore, Md.; American Concrete & Steel Pipe Co. of Los Angeles; Foley Brothers of New York City; D. W. Thurston of Los Angeles; Shofner, Gordon & Hinman of Denver, Colo.; W. E. Callahan Co. and Gunther Shirley Co. of Dallas, Tex.; A. Guthrie & Co. of St. Paul, Minn.; L. E. Dixon Co. of Los Angeles; and Hunkin-Conkey Co. of Cleveland, Ohio.

The high bid was submitted in the name of the Shasta Construction Co. of San Francisco, which is composed of Six Companies, Inc.; General Construction Co.; Guy F. Atkinson; and Walsh Construction Co.

Considering the size of the contract, almost $36,000,000, the difference between the low and high bids is of interest, this difference being only $262,907.

Shasta Dam will be the major structure of the Central Valley Federal Reclamation project. Its location is 14 miles north of Redding, Calif. The dam will control the Sacramento River and create a reservoir with a capacity of 4½ million acre-feet. The structure will be 560 feet high and the second highest dam built by the Bureau, Boulder Dam being the highest. In mass concrete to be poured, it will be second only to the Grand Coulee Dam on the Columbia River in Washington.

The power plant to be constructed at its base will have a capacity of 350,000 kilowatts.

Work on the dam must start 30 days after the contractor has received notice to proceed and must be completed in 2,000 calendar days thereafter.

The construction of this dam will do much to relieve unemployment in the territory involved.

JOHN C. PAGE,
Commissioner.

PRICE
ONE
DOLLAR
A YEAR

THE RECLAMATION ERA

VOLUME 28 • JULY 1938 • NUMBER 7

Reclamation Fulfills Its Mission

By JOHN C. PAGE, *Commissioner of Reclamation*[1]

ON JUNE 17, 1902, when President Theodore Roosevelt signed the Federal Reclamation Act, high hopes were held that important and lasting benefits would be derived from the conservation of the arid soils and the scant waters of the West. It was hoped that new opportunities to gain an American standard of living could be made available to large numbers of people who might find homes on the reclaimed land; that the natural handicaps of these big Western States could, in part, be overcome through the construction of soundly planned irrigation works with public funds on a self-liquidating basis; and that through building homes and communities the United States could be made a better and richer country.

Thirty-six years have passed. Let us look at the Federal Reclamation program from this vantage point in time and ask ourselves: "Have events justified the expectations of 1902?"

Since the Bureau of Reclamation was organized within the Department of the Interior, 34 irrigation projects have been constructed to serve more than 3 million acres of lands which recently were desert.

On the projects which have been put in operation, 900,000 people make their homes and find their livelihood on nearly 50,000 irrigated farms and in 257 towns and cities which serve and are dependent upon them. These people have built communities which support 859 public schools and 996 churches. Their banks at the close of the past year had a total of deposits of more than 225 millions of dollars.

These are normal American communities where men live and work; where they earn and achieve a measure of prosperity. These are the permanent improvements of reclamation. Before analyzing these results and attempting to determine their significance, let us see what the peculiar western conditions were which made this program necessary.

[1] Address prepared by Mr. Page and delivered by Assistant Commissioner Roy B. Williams at the Western Regional Farm Bureau Conference, held at Old Faithful Inn, Yellowstone National Park, June 23, 1938.

Need Gave Rise to Reclamation

Here lay 700 millions of acres which were arid or semiarid, or which were mountainous wastes. Most of the slight water supply was received during winter months and, with the coming of spring, it collected into a few streams and ran off, without benefit to mankind, to the sea. Only through the damming of streams, the storage of spring floods, and their distribution through canals could a little of the land be made productive and be made to support a considerable population.

As the receding frontier drew the American people westward, they came upon the arid and semiarid region, trapped its waters for fur; explored its mountains for metals; and cut into its forests, but they passed rapidly over its deserts. They crossed miles upon miles of arid land, hoping to find fresh fields; they pressed onward until they realized that it was upon the foundation of this desert that the permanent civilization in the West must be built. Then they began the easy stream diversions and irrigated the low-lying valleys and the benches near the big rivers. Gradually the irrigation systems became more complicated. Finally the unregulated flow of the streams became insufficient to the needs of developments relying upon them, and storage works were required.

It was at about this point that the Government adopted its reclamation policy. Summarized, this policy was to invest funds received from the sale of public lands in the Western States in irrigation. These funds were not to be expended as gifts, but were to be placed in a revolving fund into which the settlers upon the lands reclaimed must repay the cost of the construction of their projects. It was a simple and businesslike arrangement and, although the Reclamation Act has been amended, the principle remains unchanged.

Look at a map of the West now. The populous areas, the cities and the farms, are gathered together in spots where irrigation can be practiced, where water can be taken from the rivers or from the ground and applied to the arid land.

Of the 700 million acres in the West, 20 millions now are irrigated, and this small fraction forms the major support for 12 millions of people. Surveys show that some unused water remains available—sufficient in the estimation of the Bureau of Reclamation to irrigate, with projects which now can be considered feasible, an additional 10 millions of acres. Beyond the boundaries of these projects as yet unbuilt stretch the untracked desert and the short-grass plateaus, and above them rise the peaks of a maze of mountain ranges. Hundreds of millions of acres must forever remain uncultivated.

The growth of the West since the shaking down process which followed the gold rush to California has been keyed to its irrigation development. This relationship must be retained in the future. The Bureau of Reclamation has played an increasingly important part since 1902 in the widening of the agricultural base for this growing section. For 15 years it has been the principal agency in the field of irrigation construction. It is likely to remain such in the future because the remaining developments generally are large and costly, involving too many complications to attract private finances and being too difficult to be undertaken cooperatively by irrigation districts.

Results of Passage of Reclamation Act

What has been done under the Federal Reclamation Act, then, assumes a greater importance. To date the Bureau of Reclamation has built 138 storage and diversion dams, 20,000 miles of large canals, and has expended 237 millions of dollars on projects which have gone into operation and are settled. With the expenditure of these funds it has contributed 15 percent of the total of irrigated land in all of the arid and semiarid region.

Let us analyze these figures a little more carefully. The construction of the irrigation systems for these projects has cost less than $263 for each person who has been provided a home and, moreover, this expenditure is to be repaid. Of the $263 per capita outlay for construction, about $55 already has been

repaid, and that represents within 2 percent of all the money that has become due and payable. The provision of homes and new opportunities was the fundamental objective of the Reclamation Act. They have been provided for 900,000 persons, and for each of these, products of a cash value of more than $2,500 have been harvested from lands which recently were useless. In addition, taxable values have been created in the States exceeding $400 for each and every one of the persons living on the Federal Reclamation projects—on farms and in the cities and towns which the farms have created.

What does this mean to the public welfare? Here are a few facts. During the severe drought of the Great Plains in 1936, the President's Great Plains Committee found that in counties where adequate irrigation systems had been built and were in operation only 5 percent of the taxes were delinquent, while in many counties adjacent or nearby where there were no irrigated lands tax delinquencies amounted to 95 percent, and this difference resulted despite the fact that the appraised value of irrigated land generally was more than 10 times as high as that of dry farming and grazing lands. The support provided by irrigation for established government and institutions in this semiarid region becomes more obvious under such conditions. Irrigation lends a stability without which the very governmental structure of the West, as we know it today, could not exist.

Findings of Repayment Commission

Another bit of evidence: The Repayment Commission, in the chapter devoted to general observations in its recent report, said that its survey of relief conditions on Federal Reclamation projects revealed that bona fide farm operators in these areas were forced on relief only in a few areas. These isolated cases, it added, resulted from the fact that the farmer was a new settler who had not had the opportunity to bring his land into production, or who had been subjected to a condition over which he had no control. The records of the Bureau of Reclamation show that the average gross return per acre on its projects is more than $2\frac{1}{2}$ times that received by the farmer the country over. It is realized that the overhead costs of the irrigation farmer are necessarily higher than that of those who do not have to buy and handle their water, but in the light of the observation of the Repayment Commission it can be stated that these projects have brought a measure of prosperity to those who sought the opportunities they offered.

One can pick three States out of the arid region, combine their populations, and find that the total is less than the 900,000 who live on Federal Reclamation projects. This comparison becomes even more striking when it is realized that in each of the three States there is one Federal Reclamation project or more supporting a high percentage of that State's people.

The provision of homes and new opportunities, the support of Government and institutions, and the stabilization of the economy of a wide area are contributions to the social welfare not only of the project areas, the counties and States in which they lie, but of the whole United States.

Remember, too, that the social value of a reclamation project does not depreciate. These projects are permanent improvements which will continue to provide homes, employment, and a decent living for their people.

These values could be deprecated only if by their creation other values elsewhere were destroyed. This is not the case. The national enrichment, social and economic, which has come through the Federal Reclamation policy is clear gain.

The agriculture of the irrigated sections of the West complements that of other regions of the country.

Livestock is a major western industry. Half of the feed which supports this industry is produced on the 20,000,000 acres of irrigated land and the other half is obtained from the public ranges, hundreds of millions of acres in extent. These Western States provide the feeder stock for the pens of the midwestern farmer.

Specialty Crops Produced Under Irrigation

General farming and the production of specialty crops, which can be shipped to distant markets for a cash return, occupy the irrigation farmer. The big staple crops, of which other areas produce exportable surpluses, are not grown in appreciable quantities on irrigated land. For example, no tobacco is grown in the West. The Federal reclamation projects do not produce sufficient wheat, generally, for their own needs. The large western cities, which are the nearest markets for the products of irrigation, buy large quantities of pork and pork products from the Mississippi River Valley. Some cotton is grown, but most of it is of the long staple variety not produced elsewhere in the United States.

Every project has its specialty crop, and they are of wide variety. They range from citrus fruit to sugar beets. Winter truck is an important crop of these projects. On first thought it might be believed that the production of cherries in Idaho, or lettuce in California, or cantaloupes in Colorado, and their shipment throughout the country might provide a source of competition with gardeners and orchardists near the large cities of the East and Middle West. The products of California, Colorado, and Idaho can be sold in Boston, New York, and Chicago, however, only after being freighted from 1,000 to 3,000 miles. To bear the freight charge they must be produced out of season so far as eastern markets are concerned. They cannot compete with locally grown produce in season, and they never attempt to do so.

The growth of the West has not been made at the expense of other sections. It has, on the other hand, reflected the growth of the country. There are insufficient opportunities now in the West to take care of more than a small fraction of those seeking them. Last year 69 farm units were opened for settlement on the Tule Lake division of the Klamath project in the extreme northern section of California. More than 3,000 home seekers applied on the first day for consideration in connection with the assignment of these farms. At this time there are, in the West, more than 50,000 farm families which have been driven by drought from their homes in the Great Plains alone. Few of them can hope to find permanent lodgment on farms.

Economic Results of Construction Program

We are now engaged in the greatest construction program in the history of the Bureau of Reclamation. Projects under construction will, upon their completion, add an additional 2,500,000 acres to the watered area of these States. This construction program also will provide supplemental water for about as much more land now irrigated but with insufficient water to produce good crops. We look forward to public betterments to grow from these projects with a confidence based on the experience of the past.

When these projects are completed, opportunities will be provided, according to our estimates, for a total of 825,000 people on 41,600 farms and in cities and towns, as yet unlocated.

Some of the new projects will make settlement opportunities within a year or two, but some will take much longer. There is no possibility that all of the new lands could be thrown open at once even though it might be desirable to do so. On the contrary, they will be made available in steady progression and the last of those to be irrigated by the Grand Coulee Dam may not be ready for 20 years. Such a large and complicated development cannot be completed quickly. If it were possible by some engineering legerdemain to complete overnight the network of canals in order that we might deliver water to each farm in the 1,200,000 acres to be served by Grand Coulee Dam, we would not be able to provide farms for more than three-fifths of the families which are now refugees from the Great Plains drought alone.

One function of the Bureau has been to investigate the water and soil resources of the West and to plan for their development. The program growing out of this work is of long range. No effort has been made to keep the construction abreast of the demand for farm homes. Ultimately any such attempt must fail. As we have seen with respect to the Grand Coulee Dam, the largest unit possible of inclusion in any such program, the development must proceed slowly, while the

needs may become quickly urgent. The best that can be done is to provide a sound plan and to spread the opportunities as intelligently and as widely as can be done.

Benefits of Reclamation

No review of the contributions made by Federal Reclamation can be complete without the mention of benefits incidental to the construction or the operation of the projects. Among these are found widespread employment in building the projects and in the manufacture and transportation of materials. Among them also are contributions through the provision of flood control; by the aid of navigation; to the improvement of domestic water supplies for urban areas; through the creation of recreational centers and wildlife refuges, and through the generation of hydroelectric power. I shall dwell for a moment only on the latter, since it has received widespread public attention. But the others should not be overlooked.

From the outset projects built by the Bureau of Reclamation have grown progressively more complicated and complex. This is necessarily so since larger rivers had to be dealt with. Wherever a dam is built, a power head is created. The very scarcity of water in the West makes it a prudent policy to put this resource to multiple uses wherever feasible. It is not always economically feasible to make use of the power head created by an irrigation dam, but in recent years it has proven feasible in an increasing number of instances. Wherever this is true, the power plants have been installed.

The first power plant on a reclamation project was built to provide energy needed in the construction of an early dam. When this work was completed the plant was taken over by the settlers on the project who have enlarged it and who are still operating it. Another power plant was constructed to run pumps which were an integral part of the irrigation system of a second project. This plant is still in operation. It also has been enlarged, and the water users are producing energy in excess of the pumping requirements. This energy is being sold. Power developments such as these have had a marked influence on the progress of the projects. On the Minidoka project there is scarcely a farm house which is not lighted by electricity and scarcely a farm which does not have motors to run its heavy machinery.

Considerably later, when large dams were begun, power generation was considered in the planning of the project and the sale of power was taken into account when the calculations were made of the return of the project costs.

More than a score of power plants are being operated on our projects. Several of them are important; and one of them, that at Boulder Dam, is very large. In connection with five additional projects now being built, important power developments are being made. These are at Grand Coulee Dam in Washington, at Shasta Dam on the Central Valley project in California, on the Colorado-Big Thompson project in Colorado, at Seminoe Dam on the Kendrick project in Wyoming, and at the Elephant Butte Dam on the Rio Grande project in New Mexico and Texas.

The output from these plants like that at Boulder Dam will be used in industries, in mining and smelting, in the lighting of city homes and in rural electrification.

We believe that this by-product of irrigation should be made available for widespread use in order that the benefit derived from the investment of public funds in the projects may be shared by the largest possible number.

Again rose the questions: Have the expectations of 1902 with respect to the Federal Reclamation program been fulfilled? Has it made new opportunities? Has it created new homes? Has it given the people an American standard of living? Has it improved their lot, and has it enriched the Nation?

The answer must be:

Yes; the hopes of 36 years ago have been realized and the promise of further fulfillment still remains.

Milk River Crops

ON the Milk River project the crop prospect is now the best which has prevailed for many years. Dry land crops are also in excellent condition and the first production since 1932 is now very probable.

Central Valley Project Recreational Activities

BUREAU OF RECLAMATION employees taking active part in community life of Redding, Calif., which is the temporary headquarters of the Kennett Division of the Central Valley project, have entered a staff softball team in the Redding Twilight League and are making a bid for the city championship.

Sixteen men's teams and six girls' teams comprise three divisions of the league. The Bureau won its first three games against the 20–30 Club, 27 to 5; Ideal Laundry, 8 to 4; and Elks Club, 14 to 13; only to drop the next three to McColl's Dairy, 13 to 15; Shell Oil, 5 to 6; and Junior Chamber of Commerce, 7 to 14.

The Bureau softball squad includes A. M. Silva, manager; Albert Soliss, Louis G. Wolf, W. R. Greene, Richard Charles, A. A. Guy, Sidney Bowler, P. M. Guyer, Robert Powell, Lyle Roush, Leland Curran, Wendall M. Miller, W. I. Gardner, Smith A. Ketchum, Robert Gamer, and Francis Chorak.

Sugar Beets

SEVEN thousand acres of sugar beets have been contracted on the Belle Fourche project and outlying district, and the sugar company expects the total will reach 13,000 acres before planting time. The Black Hills plant won the Utah-Idaho achievement trophy for the fourth consecutive year in connection with the 1937 operations.

Many elements of reclamation appear in this picture, the mountains, the virgin desert, the canal, and the crops and orchard resulting from irrigated agriculture

DAMS AND CONTROL WORKS

The Bureau of Reclamation, Department of the Interior, has recently issued the second edition of *DAMS AND CONTROL WORKS,* a beautifully illustrated, instructive publication descriptive of its major dams, selected so as to provide some technical detail concerning the various types of dams built, and informative of the major engineering investigations and experiments conducted in the Bureau's world-famed laboratories.

Written by experts who had access to all the files and records of the Bureau of Reclamation, the dams are not only described, but detailed information concerning their construction, special problems met during their construction, and the unit and over-all costs is also included.

Illustrations include photographs and engineering drawings, taken from the official pictorial record made of the projects. The second edition is entirely new.

This book can be obtained by order from the Bureau of Reclamation, Department of the Interior, Washington, D. C. Checks or money orders covering the cost should accompany the order, since this speeds up handling and delivery.

The books are sold at $1 a copy in paper-bound editions, which will enhance the library of anyone interested in dams or engineering, or who desires additional information concerning the construction work of the Bureau of Reclamation.

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Report of the New South Wales Water Conservation and Irrigation Commission, F. Y., 1937, Hugh Main, Chm., H. Bevan, Secy., 48 pp.

BOULDER CANYON REPORTS:

Model studies of Penstocks and outlet works, illus., prepared in the office of the Chief Engineer, Denver, Colo., Part VI, Bulletin No. 2, 165 pp. Price $1 paper or $1.50 cloth bound.

COLORADO-BIG THOMPSON PROJECT:

Colorado - Big Thompson transmountain water diversion project, illus., by C. H. C. Braden and H. N. Goodell, Explosives Engineer, June 1938, Vol. 16, No. 6, pp. 169–176, 184–185.

COLORADO RIVER BASIN:

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Highly efficient concrete plant features Conchas Dam project, illus., L. T. Grider, Southwest Builder and Contractor, May 8, 1938, Vol. 91, No. 18, pp. 12–13 and 18.

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C. B. I. prepares to pour concrete, Fred K. Ross, Pacific Builder and Engineer, June 4, 1938, Vol. 44, No. 23, p. 52.

JENKS, ROBERT J.:

Wrenching out a cofferdam, illus., Engineering News-Record, May 12, 1938, Vol. 120, No. 19, pp. 677–9. (Grand Coulee Dam.)

KEENER, K. B.:

A few characteristics of the design for Shasta Dam, Western Construction News, May 1938, Vol. 13, No. 6, pp. 183.

LAND SETTLEMENT PROGRAM:

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Bibliography on Land Utilization, 1918–36, Mary G. Lacy, Miscel. Pub. No. 284, Department of Agriculture, January 1938, 1,508 pp. (Contains bibliography of irrigation and list of articles by A. P. Davis, Elwood Mead, F. H. Newell, J. C. Page, and others.)

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Klamath Potato Shipments

ABOUT 500 cars of potatoes were shipped from the Klamath project during May, bringing the shipments to June 1 to a total of 6,900 cars. This is the greatest season shipment ever made from the project.

Diversion of Colorado River of Texas through Marshall Ford Dam was accomplished May 24, 1938. The conduits shown are 26 feet in diameter; the discharge at the time of this exposure was approximately 1,000 second-feet

The Columbia Basin Grand Coulee Project

A NEW and profusely illustrated booklet of 40 pages on the above subject is just off the press, having been prepared and published by the Spokane Chamber of Commerce at Spokane, Wash. In this little booklet the statement is made that the 11 States west of the 100th meridian are the home of somewhat more than 9 percent of the population of the United States, but that these States contain only 4.5 percent of the farmed and cropped area of the country. Furthermore, this western section can never be agriculturally self-sustaining.

Technical Review of Norris Dam

"A TECHNICAL REVIEW of the Norris Project," recently published by the Tennessee Valley Authority, has been prepared to answer many of the requests for technical information concerning the project.

Divided into four parts—narrative description, statistical summary, photographs, and drawings—the booklet gives a description of the Norris project, the assumptions used in the design, construction methods, and equipment used. Twenty-eight selected photographs show the various phases of construction, construction equipment, and completed structures. The selection of 34 drawings shows the principal plans, sections, and details of the dam, as well as construction plant, typical concrete mixes, river diversion program, and construction schedules.

Copies of this volume may be secured from the Information Office of the Tennessee Valley Authority, Knoxville, Tenn., at $1 per copy. Checks should be made payable to the Authority.

Giant Dams Compared

AN IDEA of the comparative sizes of the country's three giant dams will be had by the following figures:

Shasta Dam, Central Valley project, California.—Height, 560 feet; crest length, 3,500 feet; base thickness, 580 feet; concrete, 5,610,000 cubic yards.

Boulder Dam, Boulder Canyon project, Nevada-Arizona.—Height, 727 feet; crest length, 1,282 feet; base thickness, 660 feet; concrete, 4,360,000 cubic yards.

Grand Coulee Dam, Columbia Basin project, Washington.—Height, 553 feet; crest length, 4,200 feet; base thickness, 520 feet; concrete, 10,250,000 cubic yards.

To further convey the idea of the immensity of these structures, the following figures are significant:

Height of Washington Monument in Washington, D. C.—555 feet 5⅛ inches; base, 55 feet 1½ inches square.

Height of Niagara Falls.—167 feet.

Cross Cut Diversion Dam Upper Snake River Project, Idaho

By J. R. SUTHERLAND, Associate Engineer, Ashton, Idaho

AS ONE of the principal features of the Upper Snake River project, the Cross Cut Diversion Dam was constructed for the purpose of diverting water from Henry's Fork, a tributary of Snake River, into the Teton River, for supplemental use on lands within the Fremont-Madison irrigation district. The Cross Cut canal is about 7 miles long, and has a diversion capacity of 600 cubic feet per second, decreasing to 400 cubic feet per second where it empties into the Teton River. The dam is located immediately below the junction of Henry's Fork and Falls River, and about 10 miles southwest of Ashton, Idaho. The Island Park Reservoir, on Henry's Fork, and the Grassy Lake Reservoir near the head of Falls River will furnish the storage water to be diverted at this point, and each is located about 50 miles upstream from the diversion dam.

The dam consists of a concrete overflow section, 355 feet long and 14.5 feet high, and is built almost entirely on a gravel foundation. The design provides for a reinforced concrete floor, 24 inches thick and 32 feet $8\frac{1}{2}$ inches wide under the O. G. section, with a reinforced concrete apron 8 inches thick extending 50 feet upstream from the face of the dam, and a 3-foot layer of heavy riprap extending 50 feet downstream. Cut-off walls were located at the upstream end of the apron, at the downstream toe of the dam, and also under the upstream face of the O. G. section. A row of dentated sills was constructed along the toe of the dam for the purpose of breaking up the velocity of the water flowing over it.

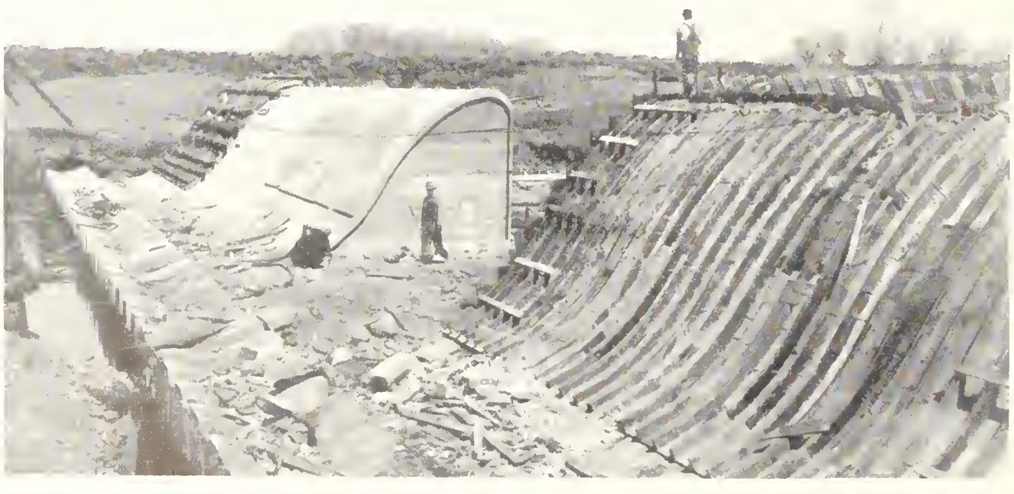
The dam was built in 35-foot sections, with a rubber water stop installed at each joint, extending from the upstream end of the apron, and continuing over the O.G. section about 6 inches from the face of the concrete. The mass concrete in the O.G. sections was placed in two lifts after the reinforced concrete floor and apron sections had been completed.

Headworks

The headworks structure for the Cross Cut Canal is located in the left abutment. Inflow into the canal is controlled by a radial gate, 18 feet wide and 12 feet 6 inches high, operated by a gasoline, engine-driven hoist mounted on top of the abutment. A concrete bench flume and transition extends from the end of the gate structure to station 2+48 on the canal. In the right abutment a radial gate structure 8 feet wide and 11 feet 6 inches high was constructed for the Last Chance Canal intake to replace the original diversion destroyed by the dam. These structures were each built on a lava rock foundation and form the abutment ties for the dam.

The foundation on which the greater portion of the dam was built is composed of a coarse compact gravel containing scattered lava boulders up to one-half cubic yard in size. Considering the type of material, the inflow of water into the excavation was remarkably small, requiring a pump capacity for the unwatering of 1,000 to 1,500 gallons per minute. A system of 4- and 6-inch tile drains, laid in the cut-off trenches and leading to a pump sump, was used to dry up parts of the foundation. These were completely filled with a sand and cement grout after the concrete work was completed. On the left side

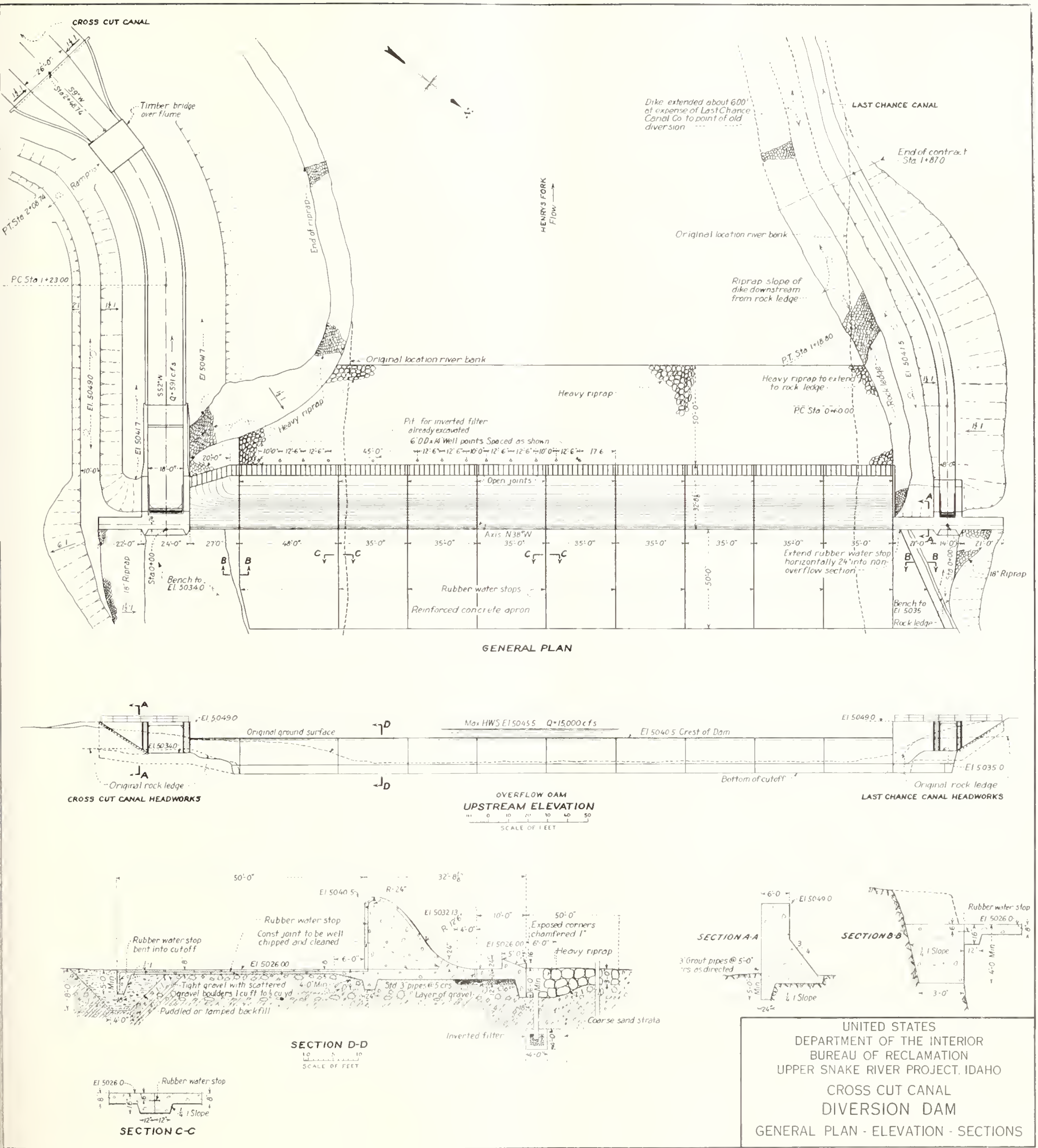
Downstream face of Cross Cut diversion dam, showing dentated sills. Looking toward right abutment. Note rubber water stop in end of completed O. G. Section



Cost of Cross Cut Diversion Dam

Description	Unit	Unit cost	Quantity	Cost to United States
Diversion and care of river during construction and unwatering foundation		(1)		$8,000.00
Excavation for structures, class 1	Cu. yd.	.20	6,090	1,218.00
Excavation for overflow section of dam	Cu. yd.	.50	13,724	6,862.00
Excavation for cut-off trenches, class 1	Cu. yd.	1.50	1,287	1,930.50
Excavation for structures, class 3	Cu. yd.	2.50	793	1,982.50
Mass concrete in diversion dam	Cu. yd.	14.00	2,334.8	32,687.20
Reinforced concrete in apron, floor slab, and cut-offs	Cu. yd.	17.00	2,026.1	34,443.70
Reinforced concrete in structures	Cu. yd.	17.00	500	8,500.00
Placing reinforcement bars	Lb.	.025	214,160	5,354.00
Installing gates and gate hoists	Lb.	.03	22,340	670.20
Pressure grouting	Cu. yd.	1.50	1,073	1,609.50
Heavy riprap from excavation	Cu. yd.	1.50	1,314	1,971.00
Heavy riprap from borrow pits	Cu. yd.	2.50	1,135	2,837.50
Other smaller miscellaneous items				4,729.80
Total payments to the contractor				112,795.90
Cost of materials furnished by the Government				31,479.00
Miscellaneous surveys, engineering, inspection, etc. (approximate)				18,540.00
Total cost to the United States [2]				162,814.90

[1] Lump sum. [2] Exclusive of canal.



of the river, a water-bearing sand strata was encountered under the compact gravel, about 10 feet below the base of the dam. In order to relieve any possible uplift pressure, in this area, twelve 6-inch well points 14 feet long were driven at 12 feet, 6 inch-centers along the downstream toe, and one inverted filter was constructed. The inverted filter, consisting of a 12-inch cast-iron pipe 14 feet long, with a sand and gravel filter built around the bottom end, was installed in one of the exploratory test holes that had been previously

Cross Cut Diversion Dam from Last Chance canal headworks on right abutment. Note the effect of dentated sills at toe of dam. About 1,600 cubic feet per second is shown flowing over the dam

excavated and used for a pump sump during construction.

Work on the diversion dam was started in September 1936 and completed in December 1937. However, only about 10 months of this period were required for the actual construction. The Cross Cut Canal headworks structure, and the first 215 feet of the dam were constructed in the fall and winter of 1936, and the spring of 1937. During this time the river was confined to a portion of the old channel about 100 feet wide near the right abutment. This channel was sufficient to carry the flow except during high water, in May and June, when it became necessary to close down the work. During the construction of the last 140 feet of the dam and the Last Chance headworks, the river was diverted through a 35-foot opening in the dam, 75 feet from the left abutment, made by omitting one of the O. G. sections above the dam floor and apron. The final closure was made by building a cofferdam around this opening and forcing the river over the completed portion of the dam. River flow during the construction period varied from 1,000 to 5,000 cubic feet per second.

Concrete yardage for the diversion dam and headworks structures included 2,526 cubic yards of reinforced concrete, using a maximum size aggregate of 1½ inches, and 2,335 cubic yards of mass concrete using a maximum size aggregate of 3 inches. The average mix proportions by weight of cement, sand, and gravel used for the reinforced concrete was 1 : 2.38 : 3.82; and for the mass concrete, 1 : 2.50 : 4.70. The contractor's concrete plant consisted of two mixers having a maximum capacity of about 12 cubic yards per hour. Approximately 40 percent of the material was handled from the mixing plant to the forms with a pumpcrete machine, and the other 60 percent in bottom dump concrete buckets, hauled on trucks and placed over the forms with a dragline. Batching was done with wheelbarrows, individually weighed on platform scales.

Enlarged Weed Program Planned for Weber County, Utah

WEBER COUNTY has approximately 3,000 acres of so-called noxious weeds. This estimate was made by the County Weed Committee after a careful survey of the infested areas. Assessment rolls of the county show that there are 51,353 acres of cultivated land.

Not all of this weed menace is located on land which has been in crop production; in fact, it is shown that not more than half is now confined directly to lands of importance to crop production. Irrigation canals and laterals, creek and other natural drainage channels, lowland native pastures, areas of heavy untillable land, and ranges all have a share of the 1,500 acres of the total weed area.

One thousand five hundred acres of tillable land devoted to production of weeds instead of crops, and 1,500 more occupied by weeds standing as a source of potential infestation such is the problem Weber County must face. One thousand five hundred acres of crop land means that the equivalent of 65 farms of average size are devoted to weeds. Our average farm acreage of cultivated land is only 23 acres. It would seem rather important that eradication be rushed in order to redeem these precious acres of land. It is also essential that these 1,500 acres of untillable land be made free from weeds in order to permanently check the possibility of infestation of crop lands. Weed-infested land pays no profit, though it is planted to crops.

What is Weber County doing and what policies will guide the efforts in weed eradication this season? During the past 4 years relief labor projects have been quite successful in the attack on the 1,500 acres of uncultivated lands. This hand labor has been used to remove fences, brush, trees, and rocks in order to prepare areas for cultivation, also to dig small patches of weeds on public highways and roads, canals, and fence lines. As the 1938 season opens, it seems that this policy will be continued. W. P. A. labor will be used in the application of chemicals. In this branch of the attack, the expense of materials will be paid by the State, the county, and the landowner.

Periodic cultivation to eradicate perennial weeds is the only economical method which can be used on large tracts of cropland. Weber County has assisted in this method of work by the use of a light tractor. The tractor may be obtained to cultivate land for weed eradication on an agreement to pay 50 percent of the cost. The county budget will meet the other 50 percent.

One tractor operated steadily all last season on this basis, and it seems that the project will require two this season. The light tractor is equipped with an 8-foot grader blade bolted to the plow beams. After the land is prepared by plow and disk, this tractor can do the weeding job, very successfully.

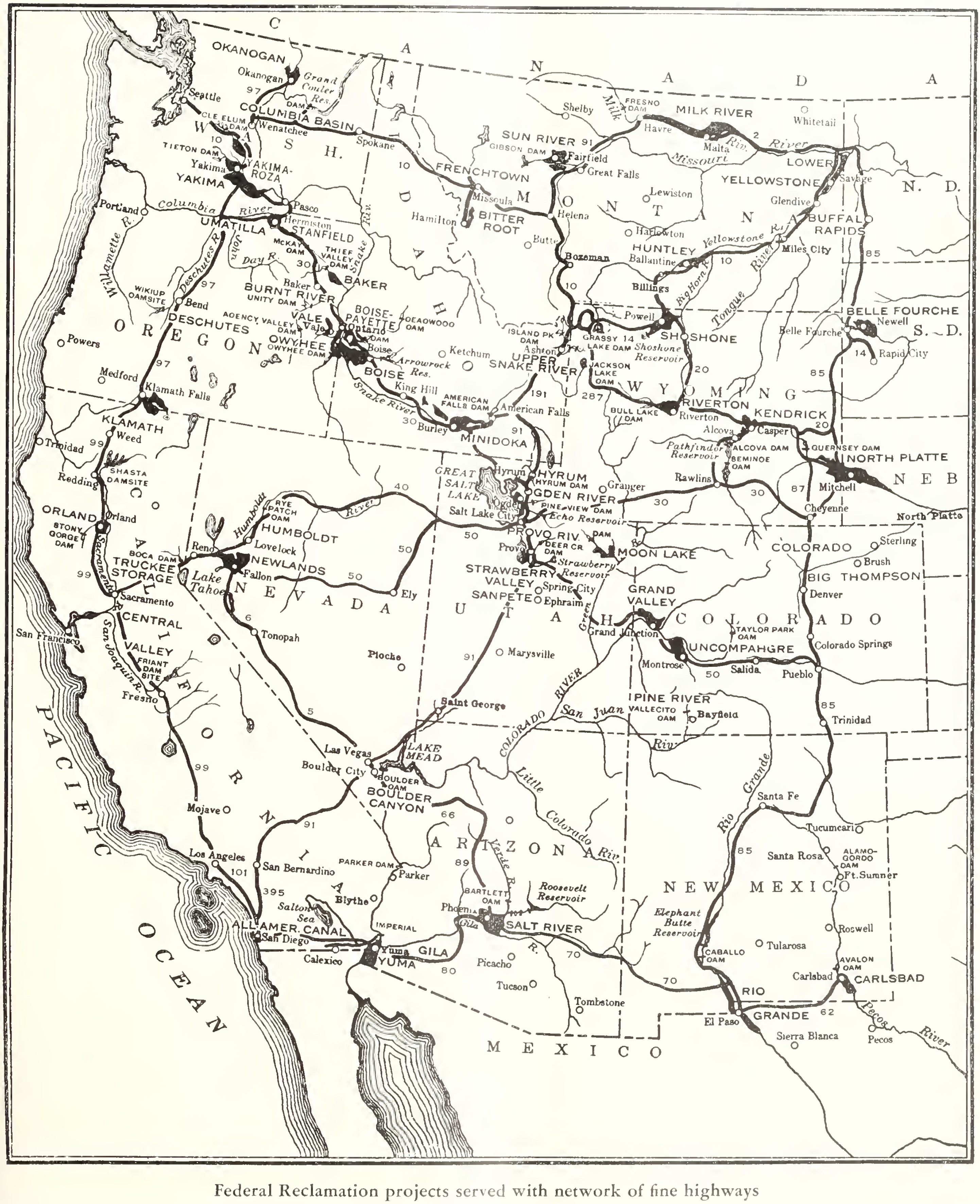
The Weber County Weed Committee is headed by W. R. McEntire, county commissioner, and George F. Stallings is supervisor of the project.

Farmers here are becoming weed conscious and close cooperation with the program is now obtained.

It is generally agreed that the 1,500 acres of tillable land must be reclaimed by complete eradication of morning glory, Canada thistle, and white top and that to prevent reinfestation, the range land, roads, canals, and waste places must be cleaned up.—*A. L. Christiansen in The Utah Farmer.*

Potatoes Prepared by New Process

A NEW process for preparing potatoes for market has been installed in the Otato Corporation factory at Burley, Minidoka project, Idaho. The potatoes are cooked and mashed, then run through a "shredder" which leaves them in small strips or shreds. These are then dried and are ready for market, and, it is stated, need only the addition of hot water and salt to prepare them for the table.



Federal Reclamation projects served with network of fine highways

Where the Gophers Go CCC Boys Rough on Rats[1]

By L. R. FIOCK, *Superintendent, Rio Grande Reclamation Project, and Regional Director, CCC*

THE inclusion of a rodent control project in the work program of the Bureau of Reclamation CCC camps on the Rio Grande Reclamation project has permitted a continuous follow-up campaign against gophers not heretofore possible. A rodent control crew has been operated from each of the valley camps on the project continuously since their allocation to the project.

During the nonirrigation season of the winter months a combined poisoning and trapping campaign is carried on in the fields where the rodents are foraging in search of food. Poisoning is accomplished by probing down to the runways and dropping in small pieces of fresh carrots poisoned with strychnine. The carrots are especially attractive to the rodents in the winter when there is a scarcity of fresh or green vegetation. Trapping is done by opening up the runways and setting in them specially made spring wire traps.

In the other months when the rodents are driven by irrigation and cultivation to higher ground, principally canal and drain banks and levees, or along the roads, the follow-up work is done by trapping.

A count is kept of the number of gophers caught in traps, but there are no means of knowing how many of the animals are killed by poisoning, and results can be reported only by acres covered. The first of the accompanying photographs shows the crew of enrollees from CCC Camp BR-39, located at Las Cruces, with the results of a day's trapping work along a canal bank in the vicinity where a recent break caused by gophers had occurred. The effectiveness of the work may be indicated by the fact that on the first time 127 gophers were caught, while in a follow-up, 3 weeks later, 32 were trapped and a third time, 2 months later, only 9 were taken.

Gopher-Catching Snakes

Sometimes the gopher catchers catch a gopher catcher in their traps, meaning a large gopher snake, usually referred to as a bull snake. The picture shows two of these along with the gophers caught by the boys that day. The snakes crawling along the gopher runways or burrows in search of their breakfast, spring the traps and are caught, from which it can be concluded that the killing of harmless rat- and gopher-catching snakes should be prohibited. In fact, the question might present itself, "why not start snake farms for the propagation of the snakes to be distributed in numbers over the valleys," to ferret out gophers.

Now and then, a nest with young gophers in it is uncovered when opening up the runways to set traps. The rapidity with which the rodents can multiply can be appreciated when it is reported that sometimes a nest is uncovered with a litter of 10 or 12 young ones in it. Usually there are five or six. In irrigated sections of the southwest the female may mother two or more broods or litters a year.

Farmers and valley residents know only too well why they object to the rodents roaming over or under their gardens, fields, and orchards in their subterranean routes of travel and foraging. To those charged with the responsibility of operating and maintaining the irrigation project works the rodents are particularly an objectionable source of annoyance. They have been frequently and most often the cause of canal bank and levee breaks or failures with attendant property and crop damage. Usually in burrowing through a canal bank the animals come out on the inside of the bank just above normal water line, and then when for any reason the water surface is raised, it begins to flow through the little tunnels, and soon the entire bank is washed away. They burrow through dry levees and then when flood water gets against them, the same thing happens as in the case of canal banks.

Rodent Burrowing Foiled

For the rodents that may escape the trapping and poisoning war waged upon them, there has been adopted a method of fooling them, or not only discouraging them in their progress of burrowing through canal banks, but of making it impossible for them to do so. Using specially made tools, deep, narrow trenches, 3 to 4 inches wide and about 4 feet deep are cut down into the canal banks and filled with concrete. Sometimes the concrete is precast in slabs or sheeting 3 inches thick, 1 foot wide and about 4 feet long, and these are set in the center of the canal bank,

Rodent-control crew of enrollees from CCC Camp BR-39 located at Las Cruces, N. Mex., with a day's catch of 127 gophers. The traps are carried on the wire hoops. Note snakes caught with the gophers.

[1] Bureau of Reclamation and Bureau of Biological Survey cooperative in use of Civilian Conservation Corps enrollees in rodent control work.

edge to edge, in a row with the aid of water jets from pressure pumps, to form a continuous underground wall. Concrete for this purpose does not need to be strong, dense, or impervious, so does not need to be rich in cement. A mix of about one part cement to nine parts of pit-run gravel produces as hard a material as a richer mix, but which, although having some small voids in it, is as effective in stopping the burrowing of rodents as the best concrete or any other material would be.

More than 20 miles of these underground walls or diaphragms have been placed in canal banks through El Paso Valley on the Rio Grande project in locations where a canal break would cause serious or extensive property damage or where the banks are high fills made of earth, particularly favorable for rodents to work in. The second group of pictures shows crews of CCC enrollees from Camp BR-4, located at Ysleta, trenching a canal bank ahead of the concrete pouring gang, and also placing the precast slabs or sheeting.

This two-phase campaign against gophers and other rodents, making it hard on their lives and obstructing their progress, has helped to reduce the number of irrigation canal breaks to a fraction of the number of their former occurrences, with corresponding reduction in crop and property damage and frequency of interruption in water service. But this alone has not been entirely responsible for the very considerable reduction in number and proportions of canal breaks. The maintaining of more uniform flow of water in the canals by closer control and regulation of the water and its more continuous day and night use also had its parts and effect.

Cooperative Rodent Control

The rodent-control job is carried on cooperatively by the Bureau of Reclamation and the Bureau of Biological Survey. The work is done by CCC enrollees trained for the job under the direction of experienced foremen approved by the district agent of the Biological Survey and has the general supervision and inspection of the field representative of that bureau.

Prior to 1932 a cooperative poisoning and trapping program was carried on during 2 or 3 winter months each year, but this lacked the follow-up trapping activity after the animals concentrated on the ditch banks and levees. In the lower valley, or Texas section of the project, supervision was supplied by the Biological Survey, labor and materials jointly by the Water Improvement District and the county, with the Bureau of Reclamation providing some of the transportation.

In the New Mexico section of the project, Biological Survey crews with their camps, have been moved during the winter months each year into the valley off the ranges and out of the mountains, with the Irrigation District paying for labor and materials. This practice is still being carried on covering those portions of the valleys too remote from the CCC camp at Las Cruces to be reached by the crew of enrollees working out of that camp. It might be stated here that all ditch riders on the project are provided with a number of gopher traps so that when they observe any particular gopher activity on their ditch banks they can set the trap to catch the rodents before a break is caused by them.

Crews of enrollees from CCC Camp BR-4, located at Ysleta, Tex., digging trench down a canal bank in which concrete is poured to stop gophers burrowing through. Lower right, placing precast concrete slabs for the same purpose.

Beet Sugar Industry in the Northwest

THE recent completion of the modern new plant of the Utah-Idaho Sugar Co. at Toppenish, Wash., is evidence of the fact that the beet sugar industry is on the come-back trail in the fertile Yakima Valley in the State of Washington.

This company erected its first plant in the Yakima Valley in 1917, and shortly thereafter set up two other plants in the lower valley. Crops were satisfactory at the start, but the inroads of the deadly "leaf-hopper" scourge finally cut production to the point where the plants could no longer be operated profitably. They were shut down in 1925, and moved out of the valley that year.

In 1931 the Bureau of Plant Industry started intensive work on the development of a beet seed that was resistant to the "leaf-hopper" or "white-fly" pest and released a seed in 1934 which proved to be satisfactory, although not perfect. Further improvements have been made and the latest blight-resisting seed is used in the plantings for the 1938 crop.

The success of the splendid work done by the Bureau of Plant Industry opened the way for the resumption of operations in the Yakima Valley by the Utah-Idaho Sugar Co., and now sugar beets promise to be one of the most satisfactory crops available to the growers in this area. Last year 5,700 acres produced an average of 15.6 tons of beets per acre, a yield far in excess of the United States average. It is expected that the 1938 plantings will reach a total of 15,000 acres, with a probable yield of about 200,000 tons.

It is interesting to speculate upon the probable growth of this industry when the millions of acres to be irrigated by the vast Grand Coulee Dam project are brought under cultivation. The beet-sugar industry is a boon to the stock-raising activities in the hill areas of eastern Washington. The pulp is an extremely valuable stock food, very high in nutritive values, and its production in large quantities will increase stock-raising activities to a great degree. At present it cannot be duplicated in food value at twice the cost. The cycle is completed by the fact that stock ranches furnish a part of the fertilizer required to maintain the fertility of the lands devoted to beet culture.—*Harold J. Baum, Valve-World, May–June 1938.*

Civilian Conservation Corps Constructs Midview Dam, Moon Lake Project, Utah

By E. S. JENSEN, *Junior Engineer, Bureau of Reclamation*

THE MIDVIEW DAM and appurtenant works recently constructed by CCC Camp BR-11 near Bridgeland, as part of the Moon Lake project in eastern Utah, is the largest earthfill dam built in the State by CCC enrollees. This undertaking is a noteworthy example of the type of permanent construction and improvement accomplished under the CCC work program as a part of the Bureau of Reclamation's program of water conservation.

Midview Reservoir, an off-stream reservoir created by Midview Dam, has a capacity of 5,800 acre-feet and stores water diverted from the Duchesne River through the 200 second-foot Duchesne feeder canal. The Midview lateral, with a capacity of 80 second-feet, conveys the water from the reservoir to the Lake Fork River and the United States Indian Service Dry Gulch Canal for use on Indian project lands. In exchange for the water delivered in this manner, the Moon Lake water users are entitled to use an equivalent amount of Lake Fork water for irrigation on higher lands of the Moon Lake project, thus equalizing the flow between the two rivers.

Construction Features

The Midview Reservoir comprises four principal construction features, namely the Midview Dam, outlet works, dike, and spillway. The dam, constructed across a dry stream channel at the east end of the reservoir site, has a length of 663 feet along the crest, a total height of 50 feet above the original stream channel and a maximum height of 68 feet above bedrock.

The main body of the dam consists of an earth embankment deposited in horizontal layers and compacted by rolling. The upstream slope is protected by a gravel and rock blanket finished to a 3½ : 1 slope, while the downstream face is backed with a fill composed of sand, gravel, and boulders finished to a 2 : 1 slope and extending downward from the crest to cover the tile drain and backfill the 12-foot drain trench at the toe of the dam. An impervious zone of selected clay, sand, and gravel was constructed to include the area of the foundation occupied by the cutoff trench and extend upward to an elevation near the crest of the dam.

A reinforced concrete cutoff wall, 10 feet in height, was constructed across the site some distance upstream from the axis. The cutoff trench with side slopes of 1 : 1 and bottom width of 15 feet was excavated a depth of 18 feet to bedrock and the concrete wall extended 5 feet into the sandstone and shale formation along the center of the trench.

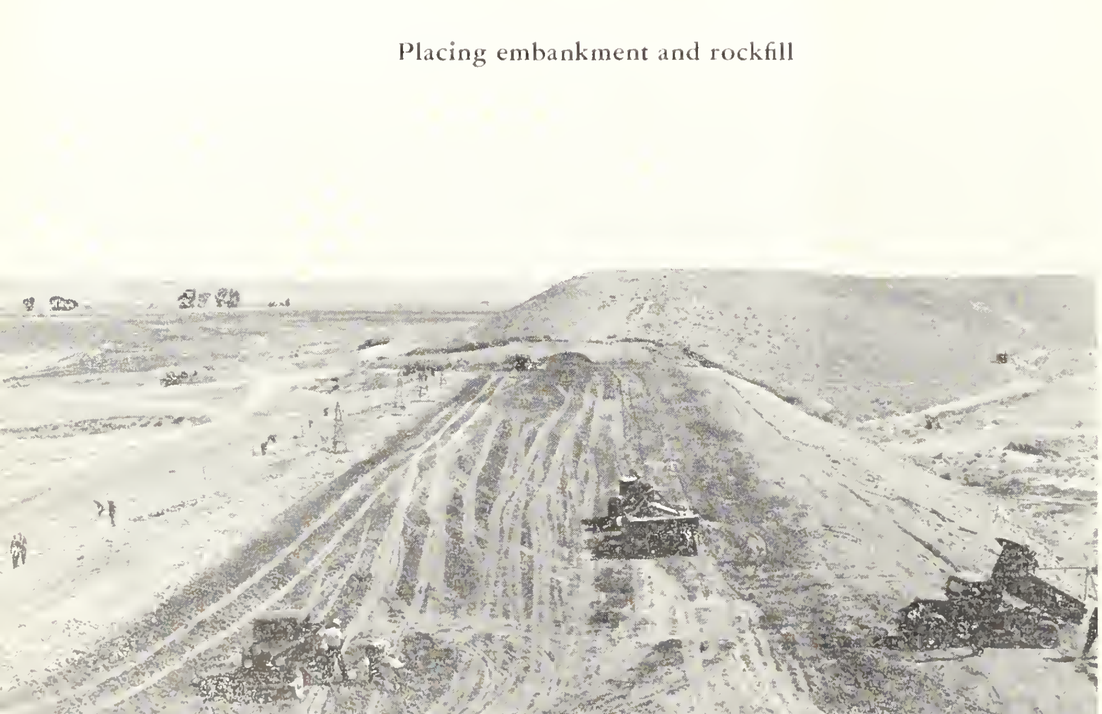
Release of water from the reservoir is accomplished by means of the 3-foot diameter reinforced concrete conduit constructed under the dam near the left abutment. A concrete trashrack structure at the inlet end of the conduit provides entrance for the flow of water which is regulated by two 2.4- by 3-foot slide gates installed approximately midway of the length of the 300-foot conduit. The gate hoists, located at the top of the gate tower level with the roadway, are operated by hand.

The reservoir is bounded on the north by a dike 2,500 feet in length which is 21 feet in height and has a top width of 27 feet finished as a graveled roadway. The compacted earth embankment is protected on the reservoir face by a gravel and boulder blanket, having a minimum thickness of 3 feet, and finished to a 3 : 1 slope. A cut-off trench 8 feet wide in the bottom with side slopes of 1 : 1 was excavated an average depth of 5 feet to bedrock and backfilled with compacted embankment materials.

An overflow spillway was constructed near the upper end of the dike which will permit the discharge of flood waters into a natural ravine leading away from the reservoir. In order to avoid damage to the existing channel as well as insure a firm foundation for a roadway crossing the spillway, the channel was protected for some distance below the overflow crest with hand-placed riprap.

The storage of sufficient water in the Midview Reservoir to submerge the trashrack structure took place in November 1937, and the quantity was increased to approximately 2,000 acre-feet the following February by diverting a small stream from the Duchesne feeder canal. During the period of storage a record has been maintained of the discharge from the drain below the dam which shows a maximum flow of 15 gallons per minute, indicating that the embankment is practically

Placing embankment and rockfill



impervious. During a month in which the precipitation was negligible and there was no inflow, the reservoir water surface dropped only 0.3 foot.

Construction Quantities

The construction of Midview Dam, dike, spillway, and outlet works by enrollees from Camp BR-11 required the stripping of 43,430 cubic yards from the foundation and borrow pits, 230,300 cubic yards of excavation in borrow pits, 173,350 cubic yards of rolled-earth embankment, 48,590 cubic yards of selected gravel and rock fill and 34,190 cubic yards of excavation in cut-off and drain trenches, spillway channel, and outlet works. Reinforced concrete for the dam and outlet works amounted to 850 cubic yards with 65,250 pounds of reinforcing steel and miscellaneous metal. Construction work on the dam and related works was finished during October 1937, excepting the parapet wall and curb which will be constructed after embankment subsidence has essentially taken place.

Construction Costs

Construction costs of the Midview Dam, outlet works, dike, and spillway are shown in the accompanying table:

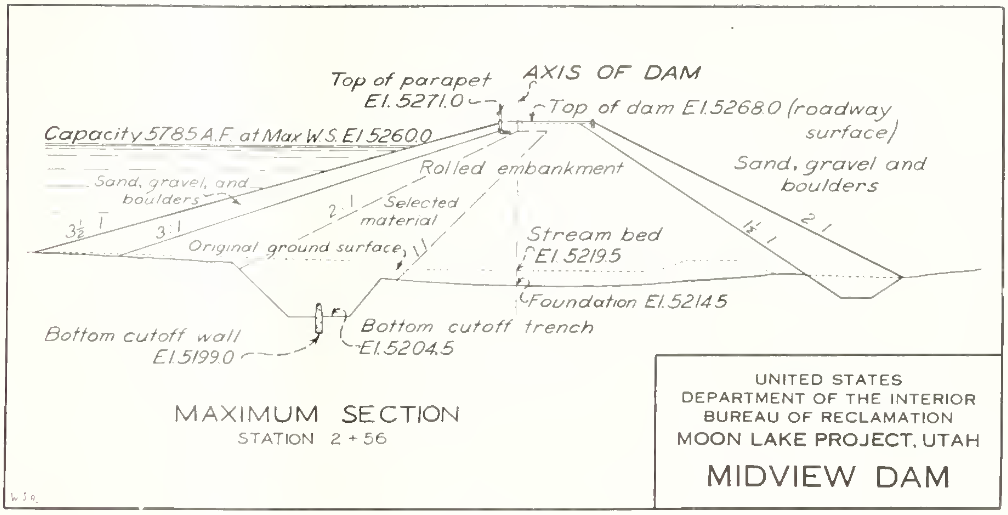
Feature	Construction costs		Total
	C. C. C. funds	Project funds	
Midview Reservoir	$3, 127. 28	$4, 235. 35	$7, 362. 63
Midview Dam	45, 922. 09	28, 550. 28	74, 472. 37
Cut-off wall	3, 306. 93	8, 325. 25	11, 632. 18
Parapet wall	[1] 2, 800. 00	[1] 3, 130. 00	[1] 5, 930. 00
Outlet works	2, 387. 68	12, 812. 39	15, 200. 07
Dike	30, 303. 04	10, 122. 04	40, 425. 08
Spillway	2, 512. 20	804. 30	3, 316. 50
Total	90, 359. 22	67, 979. 61	158, 338. 83

[1] Estimated costs of future construction.

Construction Operations

Excavation of the cut-off and drain trenches in the dam and dike was accomplished with the use of a ½-cubic yard dragline. These trenches as well as the foundation were unwatered by pumping from a sump into an outlet drain constructed below the dam. In excavating the cut-off trench into bedrock for the cut-off wall, a 160-cubic foot compressor and two paving breakers were employed. They were also used in hand tamping embankment materials where required.

Embankment materials of high quality were available on the right abutment at an elevation above the crest of the completed dam. It was determined that more uniform compaction resulted from premoistening the embankment materials in the borrow area which was accomplished by means of irrigation and sprinkling methods. The materials for the dam and dike were transported by two 8-cubic yard carry-all scrapers and from four to six 1½-cubic-yard dump trucks. Embankment was spread in 4- to 6-inch layers and compacted by rolling with a tamping roller attached to a 50-horsepower tractor.

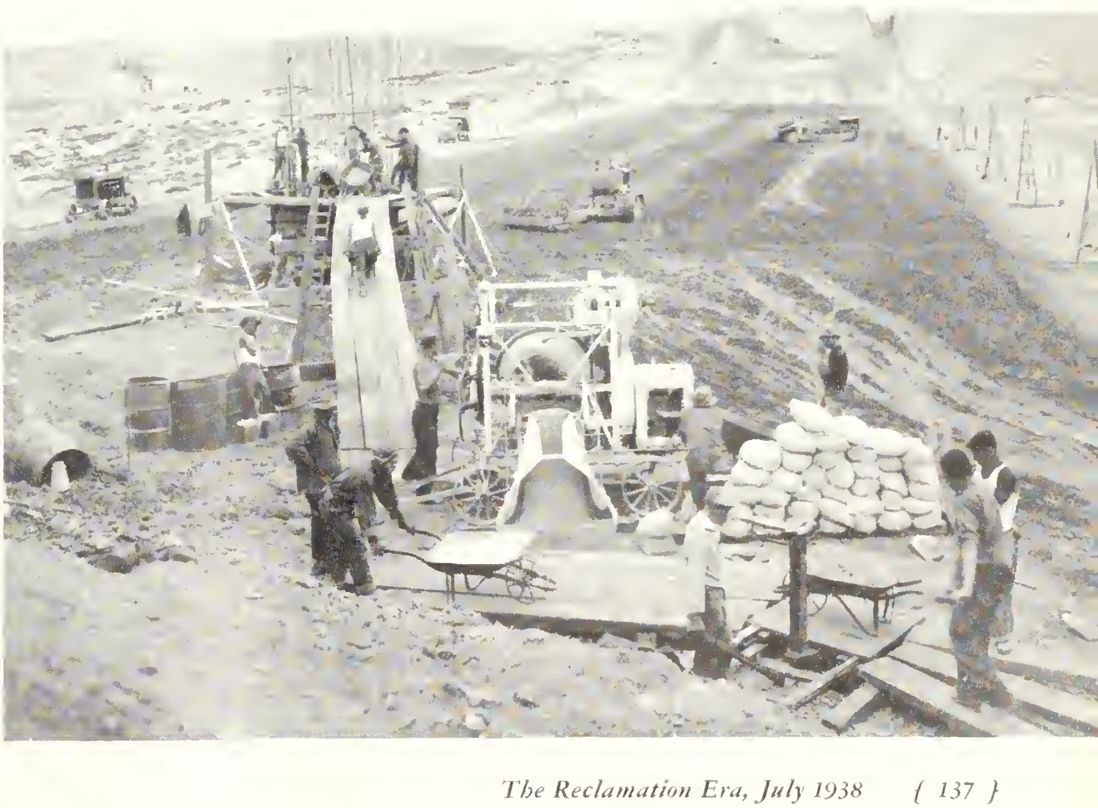


During the investigations of the dam site and at frequent intervals during construction of the Midview Dam and related features, the work was inspected by officials of the Denver office. Detailed designs for the various structures, together with a memorandum of instructions for the use of the field engineer in supervising construction were also prepared and furnished by the Denver office. A small field laboratory was used in performing standard field tests of embankment materials and concrete aggregates. Bureau of Reclamation standard control methods were employed in the placing of embankment materials in the dam and dike and in the placing of concrete in the outlet works and cut-off wall. Concrete aggregates were obtained from gravel deposits in the Duchesne River channel near Camp BR-11 where a small screening plant was constructed to obtain the desired sizes of sand and gravel.

Organization and Supervision

The construction program was carried on by a dual organization under the direction of E. O. Larson, regional director of CCC with headquarters at Salt Lake City. Field

Placing concrete in gate tower



South end of Midview Dam and portion of reservoir

Inlet Transition Lake Fork Siphon

engineering incidental to surveys and construction was performed by the field party and inspectors under the immediate supervision of Engineer L. R. Dunkley. Office engineering required in connection with preliminary plans and current construction activities was performed at both the camp headquarters and the Salt Lake Office. The superintendent of Camp BR-11 was in charge of the CCC work program which included the direction of supervisory, facilitating, and enrollee personnel.

At the beginning of construction, the CCC enrollees, whose ages did not average more than 17 to 19 years, were inexperienced in construction methods or manual labor. These circumstances necessitated the employment of some skilled workmen, which provided an opportunity for the enrollees to adapt themselves to the type of work being done. The enrollees were trained in small groups directed by a foreman or enrollee leaders on the various types of work, such as operation of trucks, tractors, and other heavy equipment, the excavation and placing of embankment, construction of concrete forms, placing reinforcement steel, and other related work. By reason of the experience gained on the work features, supplemented by class instructions pertaining to these features, many of the enrollees have availed themselves of the opportunity of job training under this CCC work project. The fact that they are trained to perform responsible work in the skilled and semiskilled occupations is evidenced by the large number of enrollees who have secured employment with contractors, other Government bureaus, State agencies, and private concerns.

South African Irrigation

THE completion of Irrigation Department schemes now nearly ready in South Africa, will submerge 90 square miles of land and place under irrigation 280 square miles, capable of sustaining 4,500 families. These schemes include the Vaal Dam near Vereeniging, Transvaal, which will irrigate the Vaal-Hartz Valley, the Loskop Dam in the Middleburg district of the Transvaal, the Kalfontein Dam in the Orange Free State, and the Egmont Dam in the Wepener district of the Free State. In the Vaal-Hartz Valley alone 3,000 families will be settled on irrigable land, and the canal system of the Kalkfontein Dam will irrigate about 30 square miles of land, in addition to that which the dam itself and Riet River below it will irrigate.

When the foregoing schemes are completed there will be 28 major State irrigation schemes in the Union, which will have cost altogether about $70,000,000, and will be capable of irrigating almost 850 square miles. On the computation based on production under the older established schemes, all of these projects are expected to yield about $40,000,000 to $50,000,000 gross return annually.

Lake Mead Storage

STORAGE in Lake Mead, the great lake created in the southwestern desert by Boulder Dam, on July 5 had reached 22,000,000 acre-feet, and the lake was two-thirds full.

Where 3 years ago only the sullen Colorado River flowed through its precipitous canyons over a series of rapids, Lake Mead now stretches upstream from the dam 112.8 miles, with a maximum depth of its waters of 505.90 feet.

A total of 6,517,011,000,000 gallons of water, which otherwise would have wasted into the sea, have been caught and stored in Lake Mead, thus regulating the river, and providing a reliable water supply for irrigators of 1,000,000 acres of land reclaimed from the deserts of Arizona and California; for domestic use by the cities served by the stream in those States; and to turn the great turbines in the powerhouse at the toe of the dam.

The water stored in Lake Mead would provide 51,100 gallons of water for every man, woman, and child in the United States, approximately the average used in a year for domestic purposes.

The lake covers 107,860 acres and extends from Boulder Dam in Black Canyon through Boulder Canyon, Travertine, and Iceberg Canyons and into the lower and previously unvisited end of Grand Canyon.

The maximum water elevation is 60 feet below the lips of the spillways. However, 7,189,000 acre-feet of additional water will be required to cause the lake to spill.

Almost 5,000,000 acre-feet of water has been added to the total stored in Lake Mead this year. The river is flowing at a rate of about 200,000 acre-feet a day at the point where it enters Lake Mead, and about 20,000 acre-feet a day are being released through the turbines to the irrigators and other water users downstream.

During May, Lake Mead rose until it covered the Lava Cliff Rapids, one of the many treacherous stretches of water recorded by the few intrepid explorers who had successfully threaded the Colorado River canyons before the construction of Boulder Dam. Other rapids will be flooded before the reservoir fills. Included among these are 241-Mile Rapids, 240-Mile Rapids, Separation Rapids, 236-Mile Rapids, Gneiss Canyon Rapids, and Bridge Canyon Rapids.

Where a few years ago only the most intrepid dared to penetrate, some of the most magnificent canyons of the Colorado River can now be entered safely by boat on the blue waters of Lake Mead. In May, more than 21,000 persons, out of 47,000 who visited Boulder Dam, made short or long trips on Lake Mead and used the beach which it has created in the old Hemenway Wash, which, a few years ago, was a blistering stretch of sand.

CONTENTS

THE RECLAMATION ERA • JULY 1938

Progress of Investigations of Projects

THE following is a brief summary of the work during the month of May 1938.

Arizona-California, Colorado River Valley surveys.—Flying and photographing of the Colorado River from Boulder Dam to Topoc and Parker Dam to Mexican Boundary and on the Gila River for 75 miles above Yuma were completed.

Colorado, Blue River transmountain diversion.—Report of investigation is in course of preparation, and a general map has been completed.

Colorado, eastern slope surveys.—Report of the Cherry Creek project was in preparation; flood control studies continued of Cherry Creek and Purgatorie Rivers, and report on North Republican River project nearly completed.

Colorado, western slope surveys.—Studies were continued of the Collbran, La Plata, Paonia, and Silt projects; the report of the Florida project was about completed, and a supplemental report made of the Mancos project.

Idaho, Cabinet Gorge investigation.—Reconnaissance of reservoir sites on Coeur d'Alene River, and studies of use of Coeur d'Alene Lake as a reservoir were made.

Southwest Idaho investigations.—Diamond drilling was continued at Twin Springs dam site; and studies continued of Cascade, Cabarton, Garden Valley, Bear Valley, and Red Fish reservoir sites. Flying and photographing of the Mountain Home area was begun.

Snake River storage.—Diamond drilling was continued at Narrows dam site, and geologic studies Burns Creek and Grand Valley dam sites.

Montana, Marias project.—Surveys of canal lines were begun and inspection made of lower Marias and Lonesome Lake dam sites.

Nebraska, Bostwick project.– Water supply studies are being continued and report is in course of preparation.

Oklahoma, Fort Supply project.—Canal surveys were begun and estimates of cost being prepared.

Oklahoma, Kenton project.—The report of the project is nearly completed.

Oregon, Goose Lake Valley project.—A preliminary examination of the project was made.

Oregon, Grande Ronde project.—Topographic survey and flood control studies continued and preparation of report begun.

Oregon, Medford project.—Drilling of South Fork and of Lake Creek dam sites completed.

South Dakota, Black Hills investigations.—Studies of possible reservoir sites for irrigation and power were continued.

Utah, projects.—Water supply studies were continued of Blue Bench, Gooseberry, Price River, and Weber River projects.

Utah-Idaho-Wyoming—Bear River surveys.—Flying and photographing of the area for aerial mosaic map was completed, and a field reconnaissance made of several reservoir sites.

Colorado River Basin investigations.—Mapping and classification of irrigable lands along Santa Clara Creek, Vernal-Ashley Valley, and Virgin River in Utah was continued; and review of plans for Green River Basin in Wyoming begun.

Improvements at Carlsbad

PLANS have been made by the property owners on the Carlsbad project for a large program of bituminous street paving, sidewalks, and gutters in the residence section of Carlsbad. Labor is to be furnished by W. P. A. allotment, and the owners are to furnish materials. The work will be under the direction of the city engineer.

Spillways like these, one on the Arizona and one on the Nevada side, ready for overflow from Lake Mead

Bureau of Reclamation Projects to Bring Additional Land Under Irrigation

Arizona

Gila project.—First unit of 150,000 acres under construction. Estimated rate of irrigation: 1943, 10,000 acres; 1944, 20,000; 1945, 30,000; 1946, 30,000; 1947, 30,000; 1948, 30,000.

California

Boulder Canyon project, All-American Canal system.—Construction of the main All-American Canal (now nearing completion) and the Coachella branch canal (not yet undertaken) will provide water for the irrigation of 521,600 acres in the Imperial Valley and 152,930 acres in the Coachella Valley. The Imperial Valley lands are now irrigated from the Imperial Canal. About 16,000 acres in the Coachella Valley are now irrigated from wells, leaving about 137,000 acres of additional lands to come in. The canal to the Coachella Valley will be completed probably in 1942, but construction of a lateral distribution system has not been authorized. It will probably be several years after the completion of the canal before the entire Coachella Valley is under irrigation.

Colorado

Pine River project.—Under construction. The total ultimate irrigable area is 69,000 acres, of which 17,000 acres are Indian lands. Additional lands to be irrigated total 35,000 acres, while a supplemental supply will be provided for 34,000 acres now under irrigation. While the storage reservoir will be completed in 1942, it will be several years before the 35,000 acres of new lands will be irrigated.

Idaho

Boise project, Payette division.—Under construction. Total irrigable area, 47,800 acres. Estimated rate of additional lands coming in: 1939, 5,000; 1940, 15,000; 1941, 15,000; 1942, 12,800.

Montana

Buffalo Rapids project.—The Glendive division of approximately 12,000 acres is now under construction, and construction work should be completed in 1942.

Sun River project.—The Sun River slope division, now under construction, comprises 17,033 acres, of which 4,556 acres are now irrigated. The remaining 12,477 acres will be brought in during 1938 and 1939.

Oregon

Vale project.—This project of 30,000 acres was completed in 1937.

Oregon-California

Klamath project.—The Tule Lake division, now under construction, comprises 33,000 acres, of which 21,500 are now irrigated; 5,100 acres will be brought in this year and 6,400 acres in 1939.

Oregon-Idaho

Owyhee project.—Under construction; 115,383 acres. Of this area, 92,433 acres are now irrigable; 21,704 acres will be brought in during 1938 and 1,246 in 1939.

Washington

Grand Coulee Dam project.—Dam and power plant are now under construction. The ultimate irrigable area of the project is 1,200,000 acres. The first unit of 150,000 acres can be brought under irrigation by 1943, and, under a reasonable plan of construction, 50,000 acres would be added yearly thereafter, the entire project to be completed in 1964.

Yakima project, Roza division.—This division of 72,000 acres is now under construction. It is estimated that the rate of completion will be about as follows: 1942, 7,000 acres; 1943, 15,000; 1944, 15,000; 1945, 15,000; 1946, 15,000; 1947, 5,000.

Wyoming

Kendrick project.—This project of 35,000 acres is now under construction. About 10,000 acres can be brought in by 1942, 10,000 in 1943, 10,000 in 1944, and 5,000 in 1945.

Riverton project.—Of this 100,000-acre project, 32,000 acres are now irrigated and 68,000 acres of additional lands will be brought under irrigation at an estimated rate of about 5,000 acres yearly, with completion about 1952.

Shoshone project, Heart Mountain division.—Under construction. Total irrigable area is 41,000 acres. The canal distribution system should be completed at the following rate: 1942, 10,000 acres; 1943, 10,000; 1944, 10,000; 1945, 11,000.

Grapefruit

THE new crop of grapefruit on the Yuma auxiliary project is developing in good shape with a noticeably heavy crop on the trees.

Erratum

ON PAGE 119 of the June issue of the ERA the title of the picture appearing in the upper right-hand corner was given as "Downstream face of Parker Dam from California side of river; powerhouse substructure, initial construction, is complete in left foreground." This title was in error. The picture is a view of the Marshall Ford Dam, and the title should read: "Downstream ends of three of the twenty-four 8½-foot diameter outlet conduits which after construction will carry the regulated flow of the Colorado River through the dam. Installation of the paradox service gates which will control the flow is about 14 percent complete."

Walnuts and Filberts

WASHINGTON and Oregon have 12,000 acres in filbert trees, or approximately 1,100,000 individual trees. A thousand acres of these are estimated to have been planted last year. Oregon has between 10,000 and 11,000 acres of the total. In that State also there are more than 20,000 acres in English walnuts.—*The Northwest.*

Additional Lands to Be Brought Under Irrigation

Project	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948
Gila, Ariz.						10,000	20,000	30,000	30,000	30,000	30,000
All-American Canal, Calif. (main canal completed in 1939; branch canal completed in 1942).											
Boise-Payette, Idaho		5,000	15,000	15,000	12,800						
Pine River, Colo. (storage reservoir completed in 1942).											
Buffalo Rapids, Mont					12,000						
Sun River-Sun River slope, Mont		12,477									
Klamath-Tule Lake, Oreg.-Calif	5,100	6,400									
Owyhee, Oreg.-Idaho	21,704	1,246									
Grand Coulee Dam, Wash.[1]						150,000	50,000	50,000	50,000	50,000	50,000
Yakima-Roza, Wash					7,000	15,000	15,000	15,000	15,000	5,000	
Kendrick, Wyo					10,000	10,000	10,000	5,000			
Riverton, Wyo.[2]			5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Shoshone-Heart Mountain, Wyo					10,000	10,000	10,000	11,000			
Total	26,804	26,123	20,000	20,000	56,800	200,000	110,000	116,000	100,000	90,000	85,000

[1] 1949 to 1964, inclusive, 50,000 acres yearly.

[2] 1949, 5,000; 1950, 5,000; 1951, 5,000; 1952, 8,000.

Status of Lands

Project	Public land			State land unsold	Indian land	Private land		Total
	Entered	Open	Withdrawn			Railroad unsold	Other	
Gila, Ariz	1,923	0	112,669	18,625	0	0	17,143	150,000
All-American Canal, Calif	962	0	10,245	1,040	15,472	21,131	625,680	674,530
Boise-Payette, Idaho	0	0	7,320	3,980	0	0	36,500	47,800
Pine River, Colo	0	0	0	600	17,000	400	51,000	69,000
Buffalo Rapids, Mont	0	0	0	0	0	0	12,000	12,000
Sun River-Sun River slope, Mont	321	0	12,477	1,250	0	0	2,985	17,033
Vale, Oreg	3,862	0	0	0	0	0	26,138	30,000
Klamath-Tule Lake, Oreg.-Calif	20,184	0	12,582	0	0	0	234	33,000
Owyhee, Oreg.-Idaho	7,939	1,204	6,560	4,904	0	134	94,642	115,383
Grand Coulee Dam, Wash	0	0	60,000	60,000	0	60,000	1,020,000	1,200,000
Yakima-Roza, Wash	120	0	1,591	2,477	0	13,562	54,250	72,000
Kendrick, Wyo	1,400	0	1,000	1,900	0	0	30,700	35,000
Riverton, Wyo	14,832	392	53,776	0	1,000	0	30,000	100,000
Shoshone, Wyo	160	0	37,564	1,907	0	174	1,195	41,000

PWA Allotments for Reclamation Announced

THE Public Works Administration has announced Presidential approval of a list of 15 PWA allotments totaling $30,500,000 for Federal Reclamation construction.

The allotments are as follows:

Arizona:	
Gila project	$2,000,000
Salt River project	565,000
California:	
All-American Canal	1,000,000
Central Valley project	4,000,000
Colorado: Colorado-Big Thompson project	2,000,000
Idaho: Boise-Payette project	500,000
Montana: Sun River project	300,000
Nevada: Truckee River storage project	80,000
New Mexico-Texas: Rio Grande project, Elephant Butte power plant	1,000,000
Utah:	
Provo River project:	
Metropolitan Aqueduct Division	2,500,000
Deer Creek Division	500,000
Moon Lake project	50,000
Washington:	
Grand Coulee Dam project	13,005,000
Yakima Project, Roza Division	1,000,000
Wyoming: Kendrick project	2,000,000

The construction of all of these projects has been authorized by the Congress and with the exception of the Colorado-Big Thompson project and the Elephant Butte power plant on the Rio Grande project, construction of major features of the projects now is under way.

Work planned under the funds made available will be started shortly.

The allotments will be used as follows:

Arizona

Gila project for construction of additional sections of the canal system and for the construction of the power line from Parker Dam to the Gila pumping plant.

The Salt River project for continuation and completion of the construction of Bartlett Dam being built on the Verde River to provide supplemental water for Indian lands and for lands of the Salt River project, and for the completion of other minor improvements contemplated under the program of construction now in progress.

California

The All-American Canal for continuation of the construction of the Coachella branch of the All-American Canal which will extend from a point near the international boundary northward past Salton Sea into the Coachella Valley.

Central Valley project for continuation of construction of Shasta Dam and power plant and additional sections of the Contra Costa Canal and other features of the project.

Colorado

Colorado-Big Thompson project for commencement of construction of the Continental Divide Tunnel and the Green Mountain Storage Dam near Kremmling and other features of the project.

Idaho

Boise-Payette project for construction of additional sections of the Boise-Payette Canal system which will distribute water to 52,000 acres of the new Payette Division of the Boise Federal Reclamation project.

Montana

Sun River project for enlargement of reservoirs and canals for the Sun River Slope unit of the Greenfields division.

Nevada

Truckee River storage project for completion of Boca Dam on the Little Truckee River.

New Mexico

Rio Grande project, Elephant Butte power plant, for commencement of construction of a power plant at Elephant Butte Dam which will have a capacity of 24,000 kilovolt-amperes. The power plant at Elephant Butte Dam was made possible through the construction of Caballo Dam downstream which will serve to reregulate the flow of the river and which is a unit of the program for rectification of the Rio Grande in El Paso and Hudspeth Counties in Texas, as well as a supplemental reservoir for the Rio Grande Federal Reclamation project.

Utah

Metropolitan Water District Aqueduct Provo project will extend from Deer Creek Reservoir, now under construction, to Salt Lake City. In addition to providing supplemental water for 7,500 acres in the vicinity of Salt Lake City, it will furnish a supplemental domestic water supply for Provo, Orem, American Fork, Lehi, and Salt Lake City. The aqueduct will be constructed of precast concrete pipe almost 5 feet in diameter, and along its route there will be two tunnels, one 2¾ miles long. The length of the aqueduct will be approximately 40 miles. The aqueduct is a part of the Provo River project, the Metropolitan Water District having subscribed for 44,000 acre-feet of storage in Deer Creek Reservoir.

Provo River project, Deer Creek Division, for continuation and construction of the Deer Creek Dam and other features of the project. Deer Creek Dam, which has just gone into construction, will be a rolled earth embankment located on the Provo River at Charleston, Utah. The maximum height of the structure will be about 155 feet. It will form a reservoir of a capacity of 150,000 acre-feet to provide a supplemental irrigation supply in the vicinity of Provo and Salt Lake City.

Moon Lake project for completion of Moon Lake Dam.

Washington

Grand Coulee Dam project for continuation of the construction of Grand Coulee Dam.

Yakima project, Roza division, for construction of additional sections of the Yakima Ridge Canal and the construction of a diversion dam on the Yakima River about 4 miles above Pomona, Wash.

Wyoming

Kendrick project for continuation of construction of Seminoe Dam and power plant and construction of additional sections of the Casper Canal.

A. S. C. E. Holds Annual Meeting

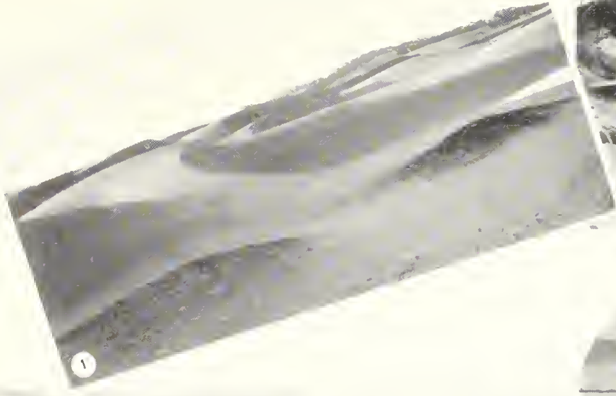
THE sixty-eighth annual convention of the American Society of Civil Engineers was held in Salt Lake City July 20–23.

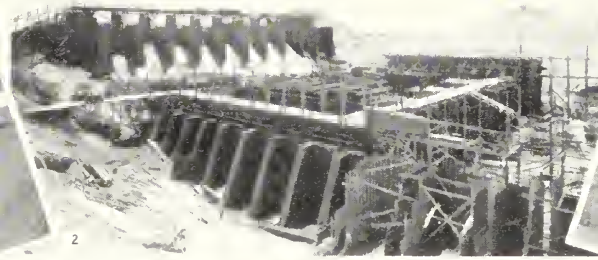
At the sessions of the technical divisions two representatives of the Bureau appeared on the program as follows:

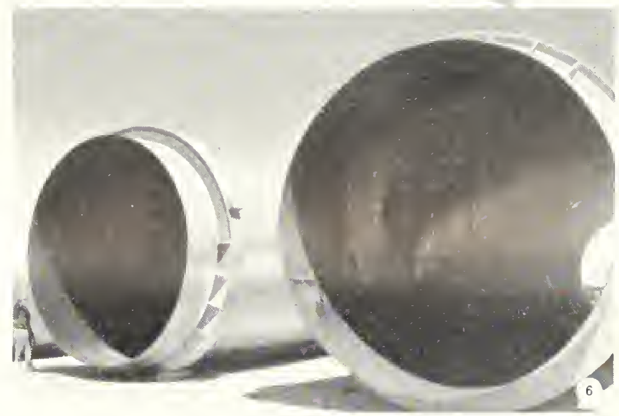
A. W. Walker, Assoc. M. Am. Soc. C. E., superintendent of the Sun River project, Fairfield, Mont., spoke on the subject "Drainage of Irrigated Lands."

E. O. Larson, engineer, Bureau of Reclamation, Salt Lake City, Utah, presented the subject "The Deer Creek Project."

Other addresses of particular interest to the Bureau were given by O. W. Israelsen, professor of irrigation and drainage engineering, Utah State Agricultural College, Logan, and T. C. Adams, associate professor, civil engineering, University of Utah. The subject of Professor Adams' address was "The Development of the Colorado River System."







1 SAND HILLS IN CALIFORNIA ABOUT 15 MILES WEST OF YUMA

2 POWER DROP NO 2 41 MILES BELOW IMPERIAL DAM LOOKING UPSTREAM AND ACROSS CANAL SHOWING RELATIVE POSITION OF GATE STRUCTURE AND POWER HOUSE SUBSTRUCTURE

3 GENERAL VIEW OF PILOT KNOB CHECK AND WASTEWAY ROAD TO ANDRADE CROSSES STRUCTURE ROCKWOOD HEADING BEGINNING OF PRESENT CANAL TO IMPERIAL VALLEY IN BACK GROUND YUMA VALLEY IN DISTANCE

4 PILOT KNOB CHECK AND WASTEWAY 20 MILES BELOW IMPERIAL DAM

5 U S HIGHWAY NO 80 BRIDGE ACROSS ALL AMERICAN CANAL 21 MILES WEST OF YUMA

6 RIVER SIPHON PIPE 15 FEET 6 INCHES IN DIAMETER

7 LOOKING UPSTREAM INTO MONOLITHIC BARRELS OF CLOSED SIPHON INLET TRANSITION END SECTIONS OF 15 FEET 6 INCH SIPHON PIPES IN PLACE

8 SIPHON PIPE PIERS IN RIVER BOTTOM 1 5 MILES WEST OF CALEXICO CALIFORNIA

9 RADIAL GATES ONE RAISED ONE LOWERED IN BY-PASS CHANNEL SECTION OF OVERFLOW CAP IN FOREGROUND

Interstate Compact Upheld by Supreme Court

COMPACTS between States settling water problems on interstate streams have been upheld by the Supreme Court against a recent attack. On May 25 the Supreme Court, in deciding the case of *Hinderlider* v. *La Plata River and Cherry Creek Ditch Co.*, upheld the compact between Colorado and New Mexico. Those States, in the early 1920's, apportioned between them the waters of the La Plata River by means of a compact ratified by the State legislatures and consented to by the Congress.

In the compact Colorado agreed to allow a certain minimum amount of water to flow down the La Plata River into New Mexico, except in periods of extremely low water when, by the terms of the compact, the State engineers of Colorado and New Mexico could arrange for a rotation method for use of the river waters. The ditch company, irrigating lands in Colorado, sued to enjoin M. C. Hinderlider, State engineer of Colorado, from shutting down the company's headgate at a time of low water when under the compact it was Colorado's turn to let the entire flow run down into New Mexico.

The ditch company and other Colorado appropriators had rights under a Colorado adjudication of 1898 to a total of 58 second-feet of La Plata waters and there were only 57 second-feet flowing at the State line when the controversy arose. If the ditch company and the other appropriators satisfied their rights, as adjudicated under the law of Colorado, there would be no water at all running down to New Mexico, although there were some New Mexico appropriations older than those of the Colorado company.

This is the sort of interstate water problems that have led to lawsuits between States in the Supreme Court of the United States. In such suits the Court makes an equitable apportionment of the water between the States. Such suits, however, drag out for years and put the States to great expense. Colorado and New Mexico had adopted the less expensive and more amicable way of settling their problem on the La Plata.

The practical question in the Hinderlider case was whether a water user of one State by proceedings against the water authorities of his State could upset the compact, or compel resort to litigation by the other State.

The Colorado Supreme Court ruled that State Engineer Hinderlider could not carry out Colorado's part of the compact, and that he must allow the Colorado appropriators to take all of the water in the river when there was not enough to satisfy their appropriations under the Colorado law. By the compact, the State court said, Colorado had attempted to cut down the vested rights of its citizens.

The Supreme Court of the United States reversed the Colorado court and upheld the interstate compact. The Court's opinion stated: "As the La Plata River flows from Colorado into New Mexico and in each State the water is used beneficially, it must be equitably apportioned between the two." The Court added that the apportionment would be binding on appropriators within the State whether the apportionment was accomplished by compact or by court decree. "Whether the apportionment of the water of an interstate stream be made by compact between the upper and lower States with the consent of Congress or by a decree of this Court, the apportionment is binding upon the citizens of each State and all water claimants, even where the State had granted the water rights before it entered into the compact." The Court also expressly upheld the rotation method of water use as an efficient and proper method of carrying out the apportionment. And it held that since Colorado had a right to only an equitable share of the La Plata River's waters, the ditch company's adjudicated rights, and all other rights acquired in Colorado, could not be for more than Colorado's equitable share as determined in the compact.

It is significant that the Court in holding that the States could settle their interstate water problems by compact as well as by litigation, noted that "The difficulties incident to litigation have led States to resort, with frequency, to adjustment of their controversies by compact."

Three interstate water apportionment suits are now pending in the Court. *Colorado* v. *Kansas*, involves the Arkansas River; *Nebraska* v. *Wyoming*, involves the North Platte River; and *Texas* v. *New Mexico*, involves the Rio Grande River. The last-named suit may never have to go through the expensive and tedious course of litigation, for a compact apportioning the Rio Grande River has already been negotiated by the States of Colorado, New Mexico, and Texas. If the States ratify the compact and the Congress consents to it, the litigation will be ended.

Hydroelectric Plants, Bureau of Reclamation

Name of project	Name of power plant	Location address	River	Total storage in acre-feet	Present generator capacity in kilovolt-amperes	Proposed ultimate installation in kilovolt-amperes
Boise	Black Canyon	Emmett, Idaho	Payette	44, 100	10, 000	10, 000
Do	Boise River	Boise, Idaho	Boise	(1)	1, 875	1, 875
Boulder Canyon	Boulder [2]	Boulder City, Nev	Colorado	30, 500, 000	376, 000	1, 323, 500
Grand Valley	Grand Valley [2]	Grand Junction, Colo	do	(1)	3, 750	3, 750
Minidoka	Minidoka	Rupert, Idaho	Snake	107, 240	10, 000	15, 000
North Platte	Guernsey	Guernsey, Wyo	North Platte	54, 610	6, 000	12, 000
Do	Lingle	Lingle, Wyo	do	(1)	1, 750	1, 750
Riverton	Pilot Butte	Pavillion, Wyo	Wind	31, 550	2, 000	2, 000
Shoshone	Shoshone	Cody, Wyo	Shoshone	456, 600	7, 000	7, 000
Yakima-Kennewick division	Prosser	Prosser, Wash	Yakima	(1)	3, 000	3, 000
Yuma	Siphon Drop	Yuma, Ariz	Yuma main canal (water from Colorado River).	1, 500, 000	2, 000	2, 000
Kendrick [3]	Seminoe [4]	Seminoe Dam, Wyo	North Platte	1, 020, 000	0	36, 000
Central Valley	Shasta [4] [5]	Redding, Calif	Sacramento	4, 389, 000	0	286, 000
Columbia Basin	Grand Coulee [4]	Coulee Dam, Wash	Columbia	9, 500, 000	0	2, 197, 500
Parker	Parker [6]	Earp, Calif	Colorado	716, 000	0	120, 000
Colorado-Big Thompson	1, 2, 3, 4, 4A and 5	Denver, Colo	Colorado-Big Thompson	152, 000	0	142, 500
Yakima-Roza	Roza	Pomona, Wash	Yakima Ridge Canal (water from Yakima River).	766, 500	0	12, 000

[1] Run of river.
[2] Not operated by the Bureau of Reclamation.
[3] Formerly Casper-Alcova project.
[4] Under construction.
[5] Formerly Kennett power plant.
[6] Proposed.

Former Employee Bedridden Becomes Artist

WRENCE A. WALLACE, formerly attor- in the Washington office of the Bureau of clamation, for the past 10 years has been lridden in the Veterans Hospital at Oteen, C., where he now paints pictures upside vn.

The creations of his gifted brushes—hills, es, winding roads, and bright-plumaged ds—are only memories from a distant past, the walls of a room in the Veterans' Ad- nistration Hospital at Oteen, N. C., during years of confinement have been his hori- . The bed on which he has lain flat on his k, gripped viselike in a cast over all that n, is his "studio." Overhead, a mirror re- ts the inverted images of his handiwork l guides the deft strokes that make the ngs he has known relive.

To go back.

A decade ago, Wallace, now 40, was a young orney in the Reclamation Service in Wash- ton. He had won that job the hard way. had come out of Idaho to take a clerkship the Compensation Commission. This fi- nced a law course in night school at George ashington University.

Then something happened.

"I guess I must have put in too many ars," he says quietly.

Stricken, he was removed to Walter Reed spital. There, the diagnosis was pulmo- ry tuberculosis. Wallace was transferred Oteen.

"The tuberculosis didn't frighten me. Many ople have that and get over it if they take omplete rest. But I had acute pains in the k and at the nerve terminals. This at t was thought to be a form of arthritis. It ned out to be tuberculosis of the spine.

"I cannot imagine anything more painful. y movement whatever provoked agony. A was especially constructed for me, with- springs and so rigid that it would not give ler the weight of the body.

"I was required to lie flat on my back and move my head. I could move my arms ttle.

"The question was to find something to do break the monotony. Just imagine being one position day and night, with nothing see but the bare ceiling.

"I had to find something to do or go crazy. ought of the books I would love to read, they were too heavy. One of the patients h a mechanical trend rigged up for me a d of upside-down table, or a rack. I could flat and look up at the book, turning the es as I read. This was pretty good, but I e that if I could find some way of con- tly using my hands and watching them ould help. It has.

"The upside-down table gave me an idea my friend rigged up a mirror on one i of it so that it could be reversed. I then began to draw something I had enjoyed as a child. With a drawing board on my body, I would look up in the mirror and in this way control the pencil. It was certainly the hard way to learn anything. After months of effort I managed to get the knack of handling the pencil.

"After that came the more tedious task of learning to draw objects. I got several books on the subject and learned as one does at the graded schools. Finally I tried to draw figures. This required the study of anatomy. I made a particular study of kinesiology. This shows the muscles in different positions and permits more realistic work.

Becoming Skilled in Art

"From the pencil I went to charcoal, pastels, and finally to oil. The transition was not so difficult, because I had learned to be patient. What has proved a handicap to many painters became a great help to me. The average painter can't view his canvas from a distance and reach it to paint at the same time. That is why Renoir had brushes made 3 feet long. So in one way my necessity of painting with the aid of a large mirror suspended over my head, through which I view the canvas, is really an advantage, because it gives me distance—to the mirror and back to the canvas. I find that it is also a great advantage in mixing colors."

Mr. Wallace works most of the time. He finds his days pretty well occupied, as he has a clientele within the hospital and on the outside—for the fame of "the painter in E-1," as he is known, has spread.

Much of his work is landscapes—scenes he has recalled from his boyhood home or perhaps from hikes in Rock Creek Park. But he enjoys also doing copies to match his skill with that of others.

Just now he is busy painting a canvas of an old Kentucky homestead, sent to him from Oklahoma by a wealthy oil man. It is a badly faded photograph of the old cabin in which the oil man was born. He is doing it in crayons and will send it along. If the sketch and the colors are approved, he will do it in oil. When he has nothing else to do, he may be found at work on a portrait of himself.

Not a bad subject by any means. The long illness and suffering have left few, if any marks. A pleasing and winning face withal. Auburn hair in profusion, a neatly trimmed mustache and blue eyes. A smile that is spontaneous and makes visitors forget his affliction.

Patience and Perseverance Conquer Disease

Thanks to the specially constructed bed he has made marked progress during these years of almost complete immobility. The pulmonary tuberculosis has completely disappeared. He no longer suffers pains from the spine, but the healing process is tremendously slow. Not only must he remain in bed for an indefinite period, but he must remain incased in the plaster cast. He could possibly sit up in bed, briefly, but there would be the chance that he would undo what has been so painfully done.

And though Mr. Wallace watches life from an upside-down point of vantage, there is nothing "upside down" about his philosophy.

"I think the secret of that is in making up the mind," he says. "I had but two alternatives. One was to brood, give up, and go insane and probably die. The other was to make the best of it and to fight. You can see that I took the latter.

"An outstanding reason is that I find that after all most people are very kind and considerate. Doctors, nurses, and others have made things easier for me.

"I have made a great many friends since I came to the hospital, probably more than I had before, because I get letters from many places, and they always remember me at the holidays. Most of them I have never seen."

Wallace's gaze wanders around the room where hang many of his works.

"You know," he says, calmly and firmly, "I believe I can beat this thing".—*William P. Flythe, in Washington Star.*

Milk River Field School

A LAND leveling and irrigation field school was held recently on the Malta division of the Milk River project by the Extension Service, Farm Security Administration, and Bureau of Reclamation cooperating. All types of machinery used in leveling and preparation of land for irrigation were employed, and the several methods of irrigation adapted to the locality were demonstrated. About 100 interested farmers were in attendance, all of whom expressed themselves generally as receiving much benefit from the school.

Churches

TWO new churches were dedicated recently on the Riverton project—the Lutheran Church on United States Highway No. 287 at the Pavillion turn-off, and the Presbyterian Church in Paradise Valley.

Federal Irrigation Congress Meets

THE annual meeting of the Federal Irrigation Congress will be held at Torrington, Wyo., September 1–3. As the Bureau of Reclamation proposes to be represented at this meeting, a further notice will appear in a later issue of the ERA.

What the Grand Coulee Project Means to Washington Agriculture[1]

THE GRAND COULEE DAM, now being constructed by the Federal Bureau of Reclamation on the Columbia River in the State of Washington, has a manifold purpose—river regulation, flood control, navigation, power, and irrigation. It provides for the maximum use of both water and land resources. This dam, which will be the largest man-made structure on earth, more stupendous than the Panama Canal and 3½ times larger than Boulder Dam on the Colorado River, has a rated capacity of 2,550,000 horsepower, and will create a storage lake 150 miles in length, extending from central Washington to the Canadian line. This lake will provide water transportation for the mineral, timber, and agricultural resources of that vast area.

By regulating the flow of the river, floods will be controlled, and the power generating capacity of every plant below the dam will be increased 50 to 100 percent. This applies to the Federal plant at Bonneville and the privately owned plant at Rock Island, both now in operation, and to any additional plants that may be constructed in the future. The entire cost of the dam and reclamation works must be repaid to the Federal Government from the sale of power and of water for irrigation.

Reclamation of Land To Be Gradual

The construction of this great dam will permit, in the course of the next half century, the reclamation of 1,200,000 acres of highly fertile land—not all at once, nor within a few years—but it will be reclaimed in units as needed. The reclamation, settlement, and development of land is a slow process, and no matter how great the need, even with favorable conditions it will be a matter of some years before the first unit will be in cultivation.

Much of the power that will be generated at the Grand Coulee Dam will be required for the development and industrial use of the many natural resources and agricultural products of this State and the Pacific Northwest. New mines will be opened and mills, smelters, and fabricating plants will be established to reduce, refine, and manufacture the minerals from these mines. Another large portion of the power will be required for the new industries that will utilize the forest products of this region. Manufacturing plants, allied and subsidiary to the industries based on products of the mines and forests, will use much additional power. All of these will bring about an industrial population that will provide a constantly increasing market for agricultural products.

Far-Reaching Benefits

The immediate and widespread benefits that will follow the construction of the Grand Coulee Dam will be from the generation and distribution of cheap power. Agriculture of this entire northwest region, not merely of the State of Washington, will receive at least two immediate and direct benefits; one, cheap electricity will be available to every farm in the region, providing all the conveniences, comforts, economies, and efficiencies that always follow the use of electricity, when obtained at moderate rates. The other benefit will be from the industries that will be established on the solid base of cheap power applied to the development of local resources, providing that best of all markets—the one at home—for the products of the farm.

The lands that ultimately will be developed, by the Grand Coulee project, will provide homes for approximately 30,000 families, indicating 150,000 persons, and in addition will support an equal urban population on the project, or a total of 300,000 people.

Profiting by experience, the development of the lands of Columbia Basin project will be free from many of the hazards that have accompanied land development in the past in all parts of the country. There will be no speculation in these potential farms, as provision against it has already been made by the passage of Federal and State laws. Let this, therefore, be a warning to those who might be tempted to speculate in these lands. A maximum farm unit is established and owners of the lands to be irrigated must sell their excess lands to settlers at the appraised prices, which will be based upon present desert land values.

All lands of the area will be properly classified as to soil and topography under Federal and State supervision. No poor lands will be included in the project. Crop surveys will be made, and the experience of farmers who have operated for years on similar lands, coupled with additional scientific research and investigations, will provide definite information as to the crops best adapted to these soil and climatic conditions, and for which there is the greatest need, without adding to existing surpluses.

And let me here remind you of this fact: Industries of the entire Nation, especially those east of the Rocky Mountains, receive direct benefits from the construction of Grand Coulee Dam. To date nearly 60 percent of the expenditures for materials, equipment, and supplies have been made to manufacturing plants of the East. In like manner, 50 percent of some manufactured goods to 100 percent of others used by the population supported by the reclamation projects of the West, are purchased from manufacturers east of the Rocky Mountains, as was disclosed in a recent survey of the well-known Yakima project in this State.

Results

The results of the development of the Grand Coulee Dam and the Columbia Basin project, according to the program I have briefly outlined, will be so far-reaching that it is difficult to visualize them. The complete development cannot be expected in this generation. It will come more or less gradually. It is not merely a matter of regulating the great Columbia River, second largest in the United States, nor of controlling recurrent floods, nor of providing for navigation, nor of power production, nor of the reclamation of some new lands, nor of establishing some industries. It is a combination of all of these, on a scale heretofore never attempted in one human program. It is a matter of building an empire, and it must be brought to fulfillment with only the larger objective in view. As this is accomplished, it will be found that agriculture will benefit in exact proportion as the general prosperity of the region and the Nation is advanced.

[1] Address by John Brooke Fink, director of the State department of conservation and development, Olympia, Wash., on the program of the Farm and Home Hour, in a national broadcast, Apr. 30, 1938.

Truckee Storage Crops

A FEW new varieties of potatoes are being tried this year on the Truckee storage project in an attempt to improve production and to fight the infestation by eel worms. A small planting of flax is also being made for experimental purposes.

Orland Olives

MORE than 600 tons of olives were processed in one form or another during the past winter in the small plants in Orland, Calif., and the operators report Orland olives have a very good reputation among the trade for their excellent quality.

CONSERVATION

A NOTE of alarm was sounded with respect to our natural resources by Jay N. ("Ding") Darling, former Chief of the United States Biological Survey and now president of the National Wildlife Federation, when he stated at the annual meeting of the New England Game Conference "There are 130,000,000 residents in the continent whose future welfare depends on natural resources, and the most we can show in the way of national interest is one little prayer meeting once a year to discuss ways and means for conservation." He drew attention to a book written by Paul B. Sears called Deserts on the March, printed by the University of Oklahoma Press, 1935, in which it is set forth that in 1960, 22 years hence, the upward curve of the population in the United States will cross the downward curve of tillable soil and leave us just 3 acres of good tillable soil per man, woman, and child in the United States. Mr. Darling comments, "Three acres is estimated as the essential amount to maintain our present standard of living. *The surplus our experts have been worrying about seems destined to an early transformation into a permanent shortage.*"

Whether we are discussing conservation of water, soil, or wildlife, the same principle is involved in Mr. Darling's comment that it has been traditional that New England looks on the West as unfriendly, and the West looks on the East as failing to understand their problems. He stated, "Sectional interests spend their time making faces at each other. Every national movement for conservation breaks down because of these sectional disputes."

In such a far-sighted policy of reclamation by irrigation, it is only by long-term planning that the most beneficial use can be made of the water of western streams, which is real life's blood to the land. Agriculture under any other form of practice cannot be profitably carried on in the sections west of the one hundredth meridian where there is an insufficient rainfall to mature crops, and water must be stored in the spring of the year when the snows are melting in order to be available for artificial application when the need arises and crops must be matured. Irrigated agriculture is farmers' insurance of consistently good crops, and in times of drought carry-over storages gladden the hearts of farmers under irrigation systems, and the acreage under the ditch becomes a veritable oasis on the desert.

With watchful eyes centered on inevitable future needs, a construction program for a 10-year period has been embarked on by the Bureau of Reclamation. Its effect, in the matter of acreage to be brought under cultivation, is shown by the following facts with respect to the projects under construction. These facts bring home more clearly than ever before how slowly lands may be brought under cultivation, which means that should a national need arise for immediate increase in production, our resources to meet such an emergency would be limited. In some places the mistaken idea exists that if a project is authorized for construction one year, lands will be brought under cultivation the following year. Depending on the size of the project, lands are not ready for cultivation after the approval of a project until from 3 to 5 years following.

With some projects well on their way within the next few years there can be an orderly settlement of lands under these projects so that increased population can be absorbed and adjusted to meet the needs of the congested city population.

The opportunity for the development of irrigation projects is surprisingly limited. The one remaining large compact section of land is under the Columbia Basin project, where 1,883,000 acres will benefit by the water stored behind the Grand Coulee Dam.—*W. A. S.*

Upstream face of Boulder Dam, spillways, and intake towers, taken from Nevada side. Lake Mead, when this picture was taken, contained 16,650,000 acre-feet. The reservoir has a capacity of 30,500,000 acre-feet

Water Conservation Conference

THE importance of water to the arid region of the United States is being recognized more and more. The conference held at Salt Lake City, July 19, under the auspices of the Utah section of the American Society of Civil Engineers, brought forth some very instructive papers by authorities on the subject. The chairman of the meeting was Prof. O. W. Israelsen, of the Utah State Agricultural College. The program featured the following:

Objectives and Activities of the Society Committee on Water Conservation, by Harry F. Blaney, Irrigation Engineer, Bureau of Agricultural Engineering, United States Department of Agriculture, Los Angeles.

Possibilities of Water Development in Utah, by T. H. Humphreys, State engineer, Salt Lake City.

What Has Resulted from Operation of the Utah Underground Water Law of 1935, by B. F. Lofgren, engineer, State engineer's office, Salt Lake City.

Snow Surveying or Mountain Hydrology as a Factor in Water Conservation, by George D. Clyde, dean, engineering and mechanic arts, Utah State Agricultural College, Logan.

The L. D. S. Church Security Program in Relation to Water Conservation, by Dr. John A. Widtsoe, Salt Lake City.

Objectives and Activities of the United States Geological Survey Looking Toward Water Conservation in Utah, by A. B. Purton, district engineer, Water Resources Branch, United States Geological Survey, Salt Lake City.

Conservation of Water Through Recharge of Underground Supply, by A. T. Mitchelson, Senior Irrigation Engineer, Bureau of Agricultural Engineering, United States Department of Agriculture, Berkeley, Calif.

Reclamation Organization Activities

W. R. Nelson Represents Department at Engineering Convention

WESLEY R. NELSON, Chief of the Engineering Division, Washington Office, on designation of Acting Secretary of the Interior Burlew, represented the Department on a committee set up in connection with the visit of foreign delegates to the International High Tension Conference who participated in the annual convention held in Washington, June 20–24, of the American Institute of Electrical Engineers. A meeting of the committee provided an opportunity for an exchange of views on technical subjects between the foreign delegates and Government officials.

On June 28–30 Mr. Nelson attended a meeting of the American Society for Testing Materials in Atlantic City, N. J.

Harvey F. McPhail in Washington

HARVEY F. McPHAIL, Senior Engineer in the Denver Office, attended, as the Bureau's representative, the annual convention of the American Institute of Electrical Engineers in Washington, D. C., June 20–24.

C. C. Beam Transferred to Deschutes

CLYDE C. BEAM, assistant to the Supervising Engineer in charge of CCC work in the Washington Office, was transferred on July 5 to the position of Assistant Engineer on the Deschutes project, Oregon. Mr. Beam left Washington on June 21, stopping at the Denver Office en route to his new official post. Three new CCC camps have been established on the project.

Supervising Engineer, CCC Concludes Trip

A. R. GOLZE, Supervising Engineer, CCC, returned to the Washington office on June 20, concluding a 7 weeks' inspection trip through the southwestern and central projects. Mr. Golze reports that the CCC programs are making excellent progress, and the value of the reclamation work of the CCC boys is generally recognized and appreciated throughout the West.

Rehabilitation of existing projects with the use of CCC forces has made rapid progress, and many canal systems formerly in poor shape have been restored to good operating condition with a resultant conservation of valuable irrigation water.

Mr. Golze advises that recreational facilities provided at reclamation reservoirs by CCC forces are very popular with the water users and fill a real need for relaxation by the irrigation farmer and his family. The Bureau of Reclamation plans to expand this type of development during the next few years.

Dr. Mead's Son Represents Bureau

TOM MEAD attended as the Bureau's representative a meeting of the International Committee on Density Currents in Washington, June 24 and 25.

Birth

J. KENNARD CHEADLE,, Assistant to the Commissioner and Chief Counsel of the Bureau, is receiving congratulations on the birth of a baby girl, which occurred on June 7. The baby will be named Jan. She weighed 7½ pounds at birth.

NOTES FOR CONTRACTORS

Specifications No.	Project	Bids opened	Work or material	Low bidder		Bid	Terms	Contract awarded
				Name	Address			
779	Kendrick, Wyo	May 9	Control and switching equipment for Seminoe power plant.	General Controls Co Bowie Switch Co Wolfe & Mann Manufacturing Co.	Minneapolis, Minn San Francisco, Calif. Baltimore, Md	[1] $12,565.00 [3] 37,115.00 [4] 695.00	F. o. b. Parco, Wyo do	June 2 Do. June 13
781	Columbia Basin, Wash.	May 20	Stop-log guides and appurtenances for penstock inlets at Grand Coulee Dam.	Arthur J. O'Leary & Son Co.	Chicago, Ill	83,000.00	Discount ½ percent	June 9
783	Yakima-Roza, Wash	May 9	Earthwork, canal lining and structures, Yakima Ridge Canal, stations 804+74.35 to 942+00.	Haas, Doughty & Jones and Marshall & Stacy.	San Francisco, Calif.	140,293.50		May 27
1059-D	Sun River, Mont	May 4	Earthwork, and structures for open drains, Greenfields division.	Jack Boyne	Council Bluffs, Iowa	25,757.40		May 24
1063-D	Owyhee, Oregon-Idaho.	May 10	Structures, South Canal laterals 25.4 to 37.6, Succor Creek division.	Henry L. Horn	Caldwell, Idaho	20,773.50		June 2
1064-D	All-American Canal, Ariz.-Calif., Gila, Ariz.	May 16	Transmitter mechanisms for remote water-level indicators and gate-hoist, float-control switches.	John W. Beam	Denver, Colo	1,065.00		June 1
1065-D	Gila, Ariz	May 18	One 19.5- by 22.0-foot fixed-wheel gate, gate frame and metalwork for gate counterweight for Gila River crossing.	Worden-Allen Co	Milwaukee, Wis	[1] 4,342.00 [2] 2,172.00	Discount ½ percent do	June 3 Do.
A 38,041-A	Columbia Basin, Wash.	Apr. 27	Couplings for 1-inch tubing	Graybar Electric Co	Denver, Colo	28,735.10	F. o. b. Elizabeth, N. J.	May 27
21,080-A	Boise-Payette, Idaho	May 12	Steel reinforcing bars, 800,000 pounds.	Colorado Fuel & Iron Co	Minnequa, Colo	24,560.00	F. o. b. Caldwell, Idaho.	June 2
785	Boise-Payette, Idaho	May 31	Earthwork and structures, Black Canyon Canal, stations 1520 to 1533+35; "A" Line Canal, stations 0 to 1040; and "D" Line Canal, stations 0 to 1284+81.	Haas, Doughty & Jones and Marshall & Stacy.	San Francisco, Calif.	172,687.00		June 21
531	do	May 11	Preparing and stockpiling 8,100 cubic yards of sand and gravel.	Quinn-Robbins Co	Boise, Idaho	11,595.00		June 17
1075-D	Columbia Basin, Wash.	June 14	Bulkhead gate liners and anchor rods	California Steel Products Co.	San Francisco, Calif.	3,547.00		June 21
1070-D	Yakima-Roza, Wash	June 1	Three 15,200-pound capacity gate hoists and 1 motor-driven, hoist-drive unit.	Commercial Iron Works	Portland, Oreg	1,898.00		Do.
1066-D	Boulder Canyon, Ariz.-Nev.	May 23	3 coupling capacitators, 3 distribution transformers, and 3 carrier line traps.	General Electric Co	Schenectady, N. Y.	[5] 7,590.00 [6] 2,310.00	F. o. b. Pittsfield, Mass. F. o. b. Schenectady, N. Y.	June 15 Do.

[1] Schedule 1. [2] Schedule 2. [3] Schedule 3. [4] Schedule 4. [5] Item 1. [6] Item 2.

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ADMINISTRATIVE ORGANIZATION OF THE BUREAU OF RECLAMATION

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E. K. BURLEW, FIRST ASSISTANT SECRETARY and Budget Officer (in charge of reclamation)

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Denver, Colo., United States Customhouse

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Projects under construction or operated in whole or in part by the Bureau of Reclamation

Project	Office	Official in charge		Chief clerk	District counsel	
		Name	Title		Name	Address
All-American Canal [1]	Yuma, Ariz.	Leo J. Foster	Constr. engr.	J. C. Thrailkill	R. J. Coffey	Los Angeles, Calif.
Belle Fourche	Newell, S. Dak.	F. C. Youngblutt	Superintendent	J. P. Siebeneicher	W. J. Burke	Billings, Mont.
Boise	Boise, Idaho	R. J. Newell	Constr. engr.	Robert B. Smith	B. E. Stoutemyer	Portland, Oreg.
Boulder Dam and power plant [1]	Boulder City, Nev.	Irving C. Harris	Constr. engr. [2]	Gail H. Baird	R. J. Coffey	Los Angeles, Calif.
Buffalo Rapids	Glendive, Mont.	Paul A. Jones	Constr. engr.	Edwin M. Bean	W. J. Burke	Billings, Mont.
Carlsbad	Carlsbad, N. Mex.	L. E. Foster	Superintendent	E. W. Shepard	H. J. S. Devries	El Paso, Tex.
Central Valley	Sacramento, Calif.	W. R. Young	Constr. engr.	E. R. Mills	R. J. Coffey	Los Angeles, Calif.
Colorado-Big Thompson	Denver, Colo.			C. M. Voyen	J. R. Alexander	Salt Lake City, Utah
Colorado River	Austin, Tex.	Ernest A. Moritz	Constr. engr.	William F. Sha	H. J. S. Devries	El Paso, Tex.
Columbia Basin	Coulee Dam, Wash.	F. A. Banks	Constr. engr.	C. B. Funk	B. E. Stoutemyer	Portland, Oreg.
Deschutes	Bend, Oreg.	C. C. Fisher	Engineer	James A. Dolphin	B. E. Stoutemyer	Portland, Oreg.
Fruit Grower's Dam	Montrose, Colo.	Clyde H. Spencer	Constr. engr.	Ewalt P. Anderson	J. R. Alexander	Salt Lake City, Utah
Gila	Yuma, Ariz.	Leo J. Foster	Constr. engr.	J. C. Thrailkill	R. J. Coffey	Los Angeles, Calif.
Grand Valley	Grand Junction, Colo.	W. J. Chiesman	Superintendent	Emil T. Ficenec	J. R. Alexander	Salt Lake City, Utah.
Humboldt	Lovelock, Nev.	Stanley R. Marean	Superintendent [2]	George B. Snow	J. R. Alexander	Salt Lake City, Utah.
Kendrick	Casper, Wyo.	H. W. Bashore	Constr. engr.	George W. Lyle	W. J. Burke	Billings, Mont.
Klamath	Klamath Falls, Oreg.	B. E. Hayden	Superintendent	W. I. Tingley	B. E. Stoutemyer	Portland, Oreg.
Milk River	Malta, Mont.	H. H. Johnson	Superintendent	E. E. Chabot	W. J. Burke	Billings, Mont.
Fresno Dam	Havre, Mont.	H. V. Hubbell	Constr. engr.	E. E. Chabot	W. J. Burke	Billings, Mont.
Minidoka	Burley, Idaho	Dana Templin	Superintendent	G. C. Patterson	B. E. Stoutemyer	Portland, Oreg.
Moon Lake	Duchesne, Utah	E. J. Westerhouse	Constr. engr.	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
North Platte	Guernsey, Wyo.	C. F. Gleason	Supt. of power	A. T. Stimpfig	W. J. Burke	Billings, Mont.
Orland	Orland, Calif.	D. L. Carmody	Superintendent	W. D. Funk	R. J. Coffey	Los Angeles, Calif.
Owyhee	Boise, Idaho	R. J. Newell	Constr. engr.	Robert B. Smith	B. E. Stoutemyer	Portland, Oreg.
Parker Dam	Parker Dam, Calif.	Howard P. Bunger	Constr. engr.		R. J. Coffey	Los Angeles, Calif.
Pine River	Bayfield, Colo.	Charles A. Burns	Constr. engr.	Frank E. Gawn	J. R. Alexander	Salt Lake City, Utah.
Provo River	Provo, Utah	E. O. Larson	Engineer	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
Rio Grande	El Paso, Tex.	L. R. Fiock	Superintendent	H. H. Berryhill	H. J. S. Devries	El Paso, Tex.
Caballo Dam	Caballo, N. Mex.	S. F. Crecelius	Constr. engr.	H. H. Berryhill	H. J. S. Devries	El Paso, Tex.
Riverton	Riverton, Wyo.	H. D. Comstock	Superintendent	C. B. Wentzel	W. J. Burke	Billings, Mont.
Bull Lake Dam	Riverton, Wyo.	Arthur P. Smyth	Resident engr.	C. B. Wentzel	W. J. Burke	Billings, Mont.
Salt River	Phoenix, Ariz.	E. C. Koppen	Constr. engr.	Edgar A. Peek	R. J. Coffey	Los Angeles, Calif.
Sanpete	Provo, Utah	E. O. Larson	Engineer	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah
Shoshone	Powell, Wyo.	L. J. Windle	Superintendent [2]	L. J. Windle [2]	W. J. Burke	Billings, Mont.
Heart Mountain division	Cody, Wyo.	Walter F. Kemp	Constr. engr.	L. J. Windle [2]	W. J. Burke	Billings, Mont.
Sun River, Greenfields division	Fairfield, Mont.	A. W. Walker	Superintendent		W. J. Burke	Billings, Mont.
Truckee River Storage	Reno, Nev.	Charles S. Hale	Constr. engr.	George B. Snow	J. R. Alexander	Salt Lake City, Utah.
Umatilla (McKay Dam)	Pendleton, Oreg.	C. L. Tice	Reservoir supt.		B. E. Stoutemyer	Portland, Oreg.
Uncompahgre. Repairs to canals	Montrose, Colo.	Denton J. Paul	Engineer [2]	Ewalt P. Anderson	J. R. Alexander	Salt Lake City, Utah.
Upper Snake River Storage [3]	Ashton, Idaho	H. A. Parker	Constr. engr.	Emmanuel V. Hillius	B. E. Stoutemyer	Portland, Oreg.
Vale	Vale, Oreg.	C. C. Ketchum	Superintendent		B. E. Stoutemyer	Portland, Oreg.
Yakima	Yakima, Wash.	J. S. Moore	Superintendent	Philo M. Wheeler	B. E. Stoutemyer	Portland, Oreg.
Roza division	Yakima, Wash.	Charles E. Crownover	Constr. engr.	Alex S. Harker	B. E. Stoutemyer	Portland, Oreg.
Yuma	Yuma, Ariz.	C. B. Elliott	Superintendent	Noble O. Anderson	R. J. Coffey	Los Angeles, Calif.

[1] Boulder Canyon. [2] Acting. [3] Island Park and Grassy Lake Dams.

Projects or divisions of projects of Bureau of Reclamation operated by water users

Project	Organization	Office	Operating official		Secretary	
			Name	Title	Name	Address
Baker (Thief Valley division) [1]	Lower Powder River irrigation district	Baker, Oreg.	A. J. Ritter	President	F. A. Phillips	Keating
Bitter Root [4]	Bitter Root irrigation district	Hamilton, Mont.	N. W. Blindauer	Manager	Elsie H. Wagner	Hamilton
Boise [1]	Board of Control	Boise, Idaho	Wm. H. Tuller	Project manager	L. P. Jensen	Boise
Boise [1]	Black Canyon irrigation district	Notus, Idaho	W. H. Jordan	Superintendent	L. M. Watson	Caldwell.
Frenchtown	Frenchtown irrigation district	Frenchtown, Mont.			Ralph P. Scheffer	Huson.
Grand Valley, Orchard Mesa [3]	Orchard Mesa irrigation district	Grand Jctn., Colo.	C. W. Tharp	Superintendent	C. J. McCormich	Grand Jctn.
Huntley [4]	Huntley irrigation district	Ballantine, Mont.	E. E. Lewis	Manager	H. S. Elliott	Ballantine.
Hyrum [3]	South Cache W. U. A.	Hyrum, Utah	B. L. Mendenhall	Superintendent	Harry C. Parker	Logan.
Klamath, Langell Valley [1]	Langell Valley irrigation district	Bonanza, Oreg.	Chas. A. Revell	Manager	Chas. A. Revell	Bonanza.
Klamath, Horsefly [1]	Horsefly irrigation district	Bonanza, Oreg.	Henry Schmor, Jr.	President	Dorothy Eyers	Bonanza.
Lower Yellowstone [4]	Board of Control	Sidney, Mont.	Axel Persson	Manager	Axel Persson	Sidney.
Milk River: Chinook division [4]	Alfalfa Valley irrigation district	Chinook, Mont.	A. L. Benton	President	R. H. Clarkson	Chinook.
Minidoka: Gravity [1]	Minidoka irrigation district	Rupert, Idaho	Frank A. Ballard	Manager	O. W. Paul	Rupert.
Pumping [1]	Burley irrigation district	Burley, Idaho	Hugh L. Crawford	Manager	Frank O. Redfield	Burley.
Gooding [1]	Amer. Falls Reserv. Dist. No. 2	Gooding, Idaho	S. T. Baer	Manager	Ida M. Johnson	Gooding.
Newlands [3]	Truckee-Carson irrigation district	Fallon, Nev.	W. H. Wallace	Manager	H. W. Emery	Fallon
North Platte: Interstate division [4]	Pathfinder irrigation district	Mitchell, Nebr.	T. W. Parry	Manager	Flora K. Schroeder	Mitchell.
Fort Laramie division [4]	Gering-Fort Laramie irrigation district	Gering, Nebr.	W. O. Fleenor	Superintendent	C. G. Klingman	Gering
Fort Laramie division [4]	Goshen irrigation district	Torrington, Wyo.	Floyd M. Roush	Superintendent	Mary E. Harrach	Torrington.
Northport division [4]	Northport irrigation district	Northport, Nebr.	Mark Iddings	Superintendent	Mabel J. Thompson	Bridgeport.
Ogden River	Ogden River W. U. A.	Ogden, Utah	Ora Bundy	President	Wm. P. Stephens	Ogden, Utah
Okanogan [1]	Okanogan irrigation district	Okanogan, Wash.	Nelson D. Thorp	Manager	Nelson D. Thorp	Okanogan.
Salt Lake Basin (Echo Res.) [3]	Weber River Water Users' Assn.	Ogden, Utah	D. D. Harris	Manager	D. D. Harris	Layton.
Salt River [2]	Salt River Valley W. U. A.	Phoenix, Ariz.	H. J. Lawson	Superintendent	F. C. Henshaw	Phoenix.
Shoshone: Garland division [4]	Shoshone irrigation district	Powell, Wyo.	M. P. McLaughlin	Irri. superintendent	Geo. W. Atkins	Powell.
Frannie division [4]	Deaver irrigation district	Deaver, Wyo.	Floyd Lucas	Superintendent	Lee N. Richards	Deaver.
Strawberry Valley [3]	Strawberry Water Users' Assn.	Payson, Utah	S. W. Grotegut	Manager	E. G. Breeze	Payson.
Sun River: Fort Shaw division [4]	Fort Shaw irrigation district	Fort Shaw, Mont.	C. L. Bailey	Manager	E. J. Gregory	Fort Shaw.
Greenfields division [4]	Greenfields irrigation district	Fairfield, Mont.	A. W. Walker	Manager	H. P. Wangen	Fairfield.
Umatilla: East division [1]	Hermiston irrigation district	Hermiston, Oreg.	E. D. Martin	Manager	Enos D. Martin	Hermiston.
West division [1]	West Extension irrigation district	Irrigon, Oreg.	A. C. Houghton	Manager	A. C. Houghton	Irrigon
Uncompahgre [3]	Uncompahgre Valley W. U. A.	Montrose, Colo.	Jesse R. Tompson	Acting superintendent	J. Frank Anderson	Montrose.
Yakima, Kittitas division [1]	Kittitas reclamation district	Ellensburg, Wash.	V. W. Russell	Manager	G. L. Sterling	Ellensburg.

[1] B. E. Stoutemyer, district counsel, Portland, Oreg.
[2] R. J. Coffey, district counsel, Los Angeles, Calif.
[3] J. R. Alexander, district counsel, Salt Lake City, Utah.
[4] W. J. Burke, district counsel, Billings, Mont.

Important investigations in progress

Project	Office	In charge of—	Title
Colorado River Basin, sec. 15	Denver, Colo.	P. J. Preston	Senior engineer.
Boise-Weiser-Payette	Boise, Idaho	Lester C. Walker	Engineer.
Cabinet Gorge	Clarks Fork, Idaho	Wm. G. Sloan	Engineer.
Kenton	Denver, Colo.	A. N. Thompson	Engineer.
Kings River-Pine Flat	Fresno, Calif.	John R. Iakisch	Constr. engineer.
Western Slope (Colo.)	Denver, Colo.	Frank C. Merriell	Engineer.
Black Hills	Denver, Colo.	R. E. Kennedy	Assistant engineer.
Eastern Slope (Colo.)	Denver, Colo.	A. N. Thompson	Engineer.
Salt Lake Basin	Provo, Utah	E. O. Larson	Engineer.
Marias	Shelby, Mont.	Fred H. Nichols	Associate engineer
Green River-Bear River	Denver, Colo.		

Issued monthly by the Bureau of Reclamation, Department of the Interior, as approved by the Director of the Budget. SALLIE A. B. COE, *Editor*.

SACRAMENTO RIVER CANYON ABOVE SHASTA DAM SITE

THE RECLAMATION ERA

AUGUST 1938

LARGEST IRRIGATION CANAL IN THIS COUNTRY · ALL-AMERICAN CANAL CALIFORNIA

PRESIDENT ROOSEVELT, *Conservation Leader*

THE following are excerpts from the President's speeches on his tour of the West just concluded:

In Oklahoma

"Oklahoma is natural-resources conscious, and I am glad that Oklahoma also appreciates so well that natural resources are national resources and that in their conserving and development, all of us have to make our plans from the national point of view.

"Slowly but surely we are developing a national policy in regard to the oil resources of the Nation.

"Probably the most important long-range problem is the use of land and water. I was sorry that I could not have stopped this morning to view the Grand River Dam project. That project is a good illustration of the national aspect of water control, for it is a vital link in the still larger problem of the whole of the valley of the Arkansas—a planning task that starts in the Rocky Mountains, west of the Royal Gorge, and runs on down through Colorado and Kansas and Oklahoma and Arkansas to the Mississippi River itself. The day will come when every drop of water that flows into that great watershed, through all those States, will be controlled for the benefit of mankind—for the growing of forests, for the prevention of soil erosion, for the irrigation of land, for the development of power, for the ending of floods and for the improvement of navigation."

In Texas

"That makes me remember one of the objectives of the national administration—better land use and an all-weather crop program. Nine years ago, when I was Governor of the State of New York, I started my interest in the better use of land.

"When I was working on this problem in Albany, I was struck by the fact that agriculture cannot be thought of or worked for just on State lines. Every crop on every farm in every county and every State has a definite tie-in—a relationship with similar crops in other States. That is why, since I have been in Washington, I have been working on the agricultural and cattle program from a national angle. For example, not only does cotton in Texas have a definite relationship to cotton in Georgia, but cotton in the South and Southwest is clearly connected with the economics of the wheat grower in the Dakotas, the cattle man of Wyoming and the potato grower of Maine. Where one has a poor year, his lack of prosperity hits all of the others. Where one is prosperous, all the others are helped."

In Nevada

"I am water conscious. I think we are getting water conscious all over the country and it has been one of my hopes, as it is yours, that through the better use of water all through the drier parts of the country we can increase the population of those drier parts of the country.

"The population of this State is altogether too small. Nevada can support and is going to support a large population. And one way of doing it is to take every kind of step, locally and through the State government and the Federal Government for the better use of the water resources."

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THE RECLAMATION ERA

VOLUME 28 • AUGUST 1938 • NUMBER 8

Electric House Heating in Mason City

By O. G. F. MARKHUS, *Assistant Engineer, Columbia Basin Project*

NCE unique as the one town in the country ithout chimneys, Mason City, the contrac- r's camp at the Coulee Dam, no longer njoys that distinction. Now it has chim- eys. An increase in the rate charged the ntractor by the power company threatens put an end to extensive domestic heat- g. Fifty-nine houses in Mason City, re- rved by the Bureau for occupancy by its wn employees, have been provided with imneys and fuel storage facilities, giving e occupants the choice of the less expensive eating with fuel or the more convenient and eanly heating by electricity.

The electric heating of Mason City occurred nder circumstances that do not prevail fre- uently. The contractor built a town which, the end of 3 or 4 years, must be turned er to the Government for a fixed sum, far low its cost or depreciated value. His in- rest lay in making the cost over a 3- or 4- ar period a minimum.

The houses were relatively inexpensive, rtly because they had no chimneys and no ovisions for fuel storage; and the elec- ical heating facilities for bunkhouses cost uch less than a central steam or hot-water ant. Since an electrical distributing sys- m for domestic service and street lighting as required, increasing its capacity to carry e domestic heating load provided an in- pensive and expeditious substitute for her heating facilities.

Transportation also had an important bear- g on the matter for, when Mason City was ilt, only a gravel road connected the site th the railhead 30 miles away, and trans- rtation facilities for heating apparatus and el could ill be spared when everything ailable was needed to move in steel for the fferdam, and indispensable material, equip- ent, and supplies.

Mason City Houses

The residences in Mason City are of frame nstruction, most of them of three stand- d types, ready-cut and partially fabricated fore delivery by trucks from Spokane, rly 100 miles away. They were designed s that the largest sections measured 28 by 14 feet. Window sash, doors, and all cabinet work were fitted at the mill, and all hard- ware was attached.

The walls of the houses are made up of shiplap on two-by-four studding, insulating paper, and drop siding. The floors are of double construction with insulating paper be- tween floors, and rest on concrete footings. Roofs, made of shiplap and composition roof ing, overhang 2 feet. Interiors are finished with thick insulating wall board.

A type A house consists of a combination living and bedroom, kitchen, bath, and closet. There are 64 of these so-called one-room cot- tages.

The 127 type B houses include in each a 12-

Mason City and Coulee Dam are again teeming with activity as the workers are returning to complete the job of raising Grand Coulee Dam to its 550-foot height. In the foreground is Coulee Dam, which houses the Government's forces, and across the Columbia River is Mason City, the Contractor's camp

by 15-foot living room, a 12- by 11-foot bedroom, closet, bath, and combined kitchen and dinette.

The 88 type C houses are similar to the type B houses, but have one more bedroom with closet.

In each house there is a 2½-kilowatt water heater, an 8½-kilowatt range, and lights, and minor conveniences ranging from ½ to 2 kilowatts. Space heaters, each including a fan, range in size from 1½ to 5 kilowatts. In each type A house there is a 3-kilowatt heater. Heaters in type B houses are of a combined rating of 13½ kilowatts, and in the type C houses 16½ kilowatts.

Dormitories

For single men there are 60 dormitories: 10 of them for foremen. Each of the workmen's dormitories contains 12 rooms 10 by 11 feet in size, to be occupied by two men. In the four corner rooms of each bunkhouse there are 3 kilowatt heaters, and in other rooms 2 kilowatt heaters. Heaters in the foremen's bunkhouses vary in size from 6 kilowatts in the living room to 2 kilowatts in inside bedrooms, and 1½ kilowatt heaters in bathrooms.

The connected load in each workmen's dormitory is 28 kilowatts in heaters and 2 kilowatts in lights; and in the foremen's dormitories 29½ kilowatts in heaters and 2 kilowatts in lights. Grouped with five workmen's bunkhouses is one building housing baths and latrines. Each includes a 28-kilowatt water heater, and 13 kilowatts in space heaters.

The use of local electrical heaters instead of a central fuel-burning plant for heating bunkhouses, accounted for a great saving to the contractor in original costs. The architect estimated the difference at about $100,000. His estimates indicate an average saving of about $200 per residence by using electrical heating instead of installing furnaces.

In 1935, the first full year of electrical operation, the connected load at this dam was 33,000 kilowatts, of which 12,250 kilowatts was in Mason City. The total consumption for the year was 42,201,000 kilowatt-hours, 12,301,630 kilowatt-hours being consumed in the homes, dormitories, and public buildings in Mason City, about 5½ million kilowatt-hours in the residences alone. The annual load factor for the town was 29.3 percent.

The contract under which the M. W. A. K. Co. bought electricity from the Washington Water Power Co., provided for a payment of $10,000 a month for 40 months plus a charge of 2½ mills per kilowatt-hour. The contractor built a 30-mile, 110,000-volt transmission line from Coulee City to the dam site, transformer substations, and distributing systems.

Residents were charged 3 mills per kilowatt-hour for electricity used; and included in the rent was an electric service charge of $5 per month for each B- and C-type house, and $4 per month for each A-type house to apply on the $10,000 monthly service charge paid by the contractor to the power company.

The use of electricity, and the average costs to tenants for a 12-month period are shown in the accompanying table.

The contractor's costs for electrical energy, based on records for about 34 months and estimates for 6 months, were $400,000 for demand charge and $410,808 for 164,323,000 kilowatts at 2½ mills, making the average $0.00493. This cost varied with the load factor, and was probably at its minimum during the period of heaviest construction, since practically all operations were then on a 24-hour schedule.

Since the contractor recovered from the Government, at the end of the contract, only about $30,000 on an electrical transmission and distributing system that cost nearly $400,000, his average charge for write-off was about $0.00222 per kilowatt-hour, making his total cost $0.00715.

The 5,950,000-kilowatt-hour domestic consumption in a typical heating season cost the contractor $42,542. From tenants he received $17,850 on electric bills and $16,632 in the rent. He absorbed the difference, $8,060. The contractor subsidized electric service at the average rate of about $28.88 per house per year. For that particular period, the contractor's loss on energy used for domestic service was about 1.35 mills per kilowatt-hour.

Electrical energy consumed in 279 all-electric houses, at Mason City, Wash.

Month	Average monthly consumption per house			Total consumption in 279 houses	Degree-days[1]
	64 "A"	127 "B"	88 "C"		
	Kw.-hrs.	*Kw.-hrs.*	*Kw.-hrs.*		
May 1935	581.6	763.7	960.4	218,733	248.5
June	501.9	584.2	684.0	161,937	50.5
July	413.0	446.9	562.1	132,647	30.0
August	437.5	472.9	575.0	140,427	18.5
September	522.4	547.9	713.7	165,835	24.5
October	764.2	965.6	1,186.6	275,972	283.0
November	1,766.0	2,496.9	3,238.1	715,086	987.5
December	1,867.6	2,709.0	3,415.6	764,137	1,041.5
January 1936	1,863.6	2,664.7	3,392.3	756,207	1,032.0
February	2,687.3	3,381.8	4,996.6	1,104,683	1,540.5
March	1,605.4	2,386.7	3,014.8	671,164	746.0
April	1,090.7	1,518.3	1,965.4	435,580	506.0
Total consumption	902,483	2,464,150	2,175,775.0	5,542,408	
Monthly average consumption	1,175.1	1,616.9	2,060.4		
Average monthly bill	$3.53	$4.85	$6.18		
Monthly electric service charge in rent	$4.00	$5.00	$5.00		
Average monthly charge for electric service	$7.53	$9.85	$11.18		
Average per kilowatt-hour	$0.0064	$0.00609	$0.00543		

MISCELLANEOUS DATA

	4-room house	3-room house		4-room house	3-room house
Connected load .... kilowatts	29.5	26.5	Mean temperature (month)[2] .... °F	32.6	29.3
Average monthly consumption (1935) kilowatt hours	1,814.0	1,456.0	Maximum daily consumption kilowatt hours	356.0	269.0
Average annual consumption .... do	21,770.0	17,480.0	Mean temperature (day)[2] .... °F	11.5	−5.0
Maximum monthly consumption .... do	5,323.0	4,670.0			

[1] Degree-days per month below a mean temperature of 65° F.

[2] The maximum monthly consumption in the 4- and 3-room houses occurred in different months. The temperatures given are means for those different months. Maximum daily consumptions in houses of the two sizes occurred on different days, for which the mean temperatures are given.

Amendment of Original Boulder Dam Power Contract

THE Boulder Dam power contract with the Metropolitan Water District of Southern California was revised by a new contract signed by Secretary of the Interior Ickes on July 14, allowing the district a longer time in which to use its full amount of power without reducing the totals which must eventually be paid to the United States Government. A 2-year extension, from June 1, 1938, to June 1, 1940, is granted under the new contract as the time required for the district to take the first of its power, and it is given 15 years thereafter before absorbing the 36 percent of the total Boulder Dam power for which it contracted in 1930.

Klamath Spuds

ABOUT 300 cars of potatoes were shipped from the Klamath project during the early part of June, making the total shipments for the season about 7,200 cars, the greatest season's shipment made from the project.

Seminoe Dam Nears Completion

THE storage of water back of Seminoe Dam on the Kendrick project, will begin next winter. The distribution to serve the first 35,000 acres of arid land should be completed in 1940. These lands are located in the vicinity of Casper, Wyo.

NOTES FOR CONTRACTORS

pecifica- ons No.	Project	Bids opened	Work or material	Low bidder		Bid	Terms	Contract awarded
				Name	Address			
775	Kendrick, Wyo	*1938* May 31	Transformers, oil circuit breakers, disconnecting switches and lightning arresters.	American Transformer Co	Newark, N. J	$174,090.00	F. o. b. Parco, Greeley, and Cheyenne.	*1938* June 27
				Pacific Electric Manufacturing Corporation.	San Francisco, Calif.	[2] 67,600.00	do	Do.
				Menco Engineering and Manufacturing Co.	Long Island City, N. Y.	[3] 24,460.00	do	Do.
				Royal Electric Manufacturing Co.	Chicago, Ill	[4] 440.00	do	Do.
				General Electric Co	Schenectady, N. Y.	[5] 9,394.56	do	Do.
776	Central Valley, Calif	May 20	Earthwork, tunnel, canal lining and structures, Contra Costa Canal, stations 209+65-638.	Pearson, Minnis and Moody, and Werner and Webb.	Los Angeles, Calif.	340,992.20		June 30
780	do	June 1	Construction of Shasta dam and power plant.	Pacific Constructors, Inc	do	35,939,450.00		July 1
782	All-American Canal, Ariz.-Calif.	June 3	Earthwork, Coachella Branch Canal, stations 2+24-2293.	W. E. Callahan Construction Co. and J. P. Shirley.	do	382,872.00		June 24
784	Central Valley, Calif	June 2	Construction of warehouse, concrete culvert, drainage channel and grading for storage yard.	Heafey-Moore Co. and Frederickson & Watson Construction Co.	San Francisco, Calif.	83,182.00		July 6
790	Boise-Payette, Idaho	June 13	Earthwork, canal lining and structures, Black Canyon Canal, stations 482-782+80.	J. A. Terteling & Sons	Boise, Idaho	239,406.50		Do.
791	All-American Canal, Calif.	June 27	Construction of Alamo River and New Briar Canal crossings and Central Main Canal check and turnout at station 3543+76.	Atlas Construction Co	Pasadena, Calif. [18]	269,832.10		July 20
1060-D	Kendrick, Wyo	May 10	Wood poles, wood cross arms, insulators and pole hardware for transmission lines.	Graybar Electric Co	New York, N. Y	[1] 105,872.75	F. o. b. Everett, Spokane, Wash., Sandpoint, Idaho.	June 30
				General Electric Supply Corporation.	Denver, Colo	[6] 18,842.00	F. o. b. Cheyenne. Discount 1 percent.	Do.
				do	do	[5] 17,138.43	F. o. b. Pittsburgh. Discount 2 percent.	Do.
				Seyler Manufacturing Co	Pittsburgh, Pa	[7] 3,338.60	do	Do.
				American Chain & Cable Co.	Monesson, Pa	[8] 8,228.23	F. o. b. Cheyenne. Discount 2 percent.	Do.
				Joslyn Manufacturing & Supply Co.	Chicago, Ill	[9] 1,796.80		Do.
				Seyler Manufacturing Co	Pittsburgh, Pa.	[10] 405.00	F. o. b. Cheyenne	Do.
				Hendrie & Bolthoff Manufacturing and Supply Co.	Denver, Colo	[11] 828.75		Do.
				General Electric Supply Corporation.	do	[12] 972.32	F. o. b. Pittsburgh. Discount 2 percent.	Do.
1069-D	Buffalo Rapids, Mont	May 31	Gate valves, pumping units and one 10-ton traveling crane.	The Chapman Valve Manufacturing Co.	Indian Orchard, Mass.	[13] 3,288.00	Discount 2 percent	June 27
				Mountain States Machinery Co.	Denver, Colo	[14] 234.60	F. o. b. Los Angeles	Do.
				Hendrie & Bolthoff Manufacturing and Supply Co.	do	[15] 408.00	F. o. b. Glendive, Mont. Discount 2 percent.	June 22
				Cyclops Iron Works	San Francisco, Calif.	[16] 1,691.00	Discount 1 percent	June 25
1070-D	Yakima-Roza, Wash	June 1	Three 15,200-pound capacity gate hoists and one motor-driven hoist-drive unit for Pomona Siphon wasteway.	Commercial Iron Works	Portland, Oreg	1,898.00	Discount ½ percent	June 21
1071-D	All-American Canal, Ariz.-Calif., Gila, Ariz.	June 6	2 trashrack rakes for Imperial Dam.	General Iron and Steel Works.	do	14,925.00		June 30
1072-D	Boulder Canyon, Ariz.-Nev.	June 2	Ventilating and air-cooling equipment for Boulder power plant.	The Bishop & Babcock Manufacturing Co.	Cleveland, Ohio	[17] 3,525.00	F. o. b. Boulder City. Discount 2 percent.	June 27
1074-D	do	June 7	Line hardware and conductor fittings for Southern California Edison switchyard.	General Electric Supply Corporation.	Denver, Colo	[1] 2,863.08	F. o. b. Boulder City	June 29
				Bowie Switch Co	San Francisco, Calif.	[2] 768.00	do	June 28
				General Electric Supply Corporation.	Denver, Colo	[3] 124.90	do	June 29
				do	do	[4] 83.20	do	Do.
				Burndy Engineering Co., Inc.	New York, N. Y	[5] 195.57	do	Do.
				General Electric Supply Corporation.	Denver, Colo	[7] 198.00	do	Do.
1075-D	Columbia Basin, Wash	June 14	Bulkhead gate liners and anchor rod for Grand Coulee power plant.	California Steel Products Co.	San Francisco, Calif.	3,547.00		June 21
1085-D	Kendrick, Wyo	June 24	Structural-steel roof framing for Seminoe power plant.	American Bridge Co	Denver, Colo	5,932.00	F. o. b. Gary, Ind	June 28
591	Boise-Payette, Idaho	June 15	Preparing and stock piling 10,000 cubic yards of sand and 15,000 cubic yards of gravel.	Chester T. Lackey	Ontario, Oreg	28,750.00		July 6
,090-A	Columbia Basin, Wash	June 22	Steel reinforcing bars, 8,000,000 pounds.	Bethlehem Steel Co	San Francisco, Calif.	214,260.00	F. o. b. Odair, Wash. Discount ½ percent b. p. v.	July 21
,085-A	All-American Canal, Ariz.-Calif.	June 24	Steel reinforcing bars, 747,770 pounds.	do	do	19,027.34	F. o. b. Los Angeles. Discount ½ percent b. p. v.	July 22
,472-A	Riverton, Wyo	May 12	Electrical conductor and accessories	Aluminum Co. of America.	Washington, D. C.	20,233.02	F. o. b. Massena, N. Y.	July 8
1084-D	Columbia Basin, Wash., Colorado River, Tex.	June 27	Bulkhead gates, two 12- by 12-foot and one 8- by 14-foot.	Hansel-Elcock Co	Chicago, Ill	[19] 6,276.12	Discount ½ percent	July 11
1087-D	North Platte, Nebr.-Wyo.	do	One 34,500-volt, 3-phase, 60-cycle, 600-ampere oil circuit breaker.	Kelman Electric & Mfg. Co.	Los Angeles, Calif.	[13] 3,420.00	F. o. b. Guernsey, Wyo.	July 7
			One 34,500-volt, 3-phase, station-type, lightning arrester.	Graybar Electric Co., Inc	Denver, Colo	[14] 840.00	do	July 9
1089-D	Gila, Ariz	July 5	One gasoline-engine-driven gate hoist for operating 19.5- by 22-foot fixed-wheel gate.	Smith Corporation d. b. a. General Iron & Steel Works.	Portland, Oreg	5,698.00		July 12
098-D	Kenrick, Wyo	July 18	Structural-steel crane girders for Seminoe power plant.	Bethlehem Steel Co	Chicago, Ill	3,277.00		July 23
096-D	Yakima, Wash	July 22	Radio telephone apparatus	Communication Equipment & Eng. Co.	do	2,194.00		July 28

[1] Schedule 1.
[2] Schedule 2.
[3] Schedule 3.
[4] Schedule 4.
[5] Schedule 5.
[6] Schedules 2 and 9.
[7] Schedule 6.
[8] Schedule 7.
[9] Schedule 8.
[10] Schedule 11.
[11] Schedule 12.
[12] Schedule 13.
[13] Item 1.
[14] Item 2.
[15] Item 3.
[16] Item 4.
[17] Items 1 and 2.
[18] Schedules 1 and 2.
[19] Items 2, 4 and 5.

The Desilting Works at Imperial Dam

By D. M. FORESTER, *Engineer, All-American Canal*

THE All-American Canal project, located in the southeastern section of California, is to provide the Imperial Valley with an All-American water system. The Imperial Valley is a part of the Salton Sink, a below-sea-level basin which at one time was a portion of the Gulf of California, having been separated from it by the formation of the delta of the Colorado River. The sea that once covered this area long since has evaporated; the lowest part of the basin is 287 feet below the level of the sea and more than 300 feet below the bed of the Colorado River. Imperial Valley is the irrigable portion lying in the southern section of the basin; the portion north of the Salton Sea is known as the Coachella Valley.

Two principal problems have faced the farmers in the Imperial Valley. These are the erratic nature of the Colorado River and Mexican control of their main canal which looped through Mexican territory for a distance of more than 40 miles between its intake and principal feeder canals in California. The Boulder Canyon Act of 1928 authorized both Boulder Dam, for regulation of the Colorado River, and an All-American Canal for Imperial and Coachella Valleys.

Among the many problems encountered in the studies and design of the All-American Canal System, one was the removal of the heavy silt load carried by the Colorado River before passing the water to the canal and thus eliminating its deposition in the canal and upon the farm lands. The cost of cleaning the canals and laterals in the original system of the Imperial Irrigation District has been from $800,000 to $1,000,000 annually, an almost unsupportable item of cost in the operation and maintenance. Contrary to layman belief, the reservoirs formed by Boulder and Parker Dams, upstream 300 miles and 150 miles, respectively, will have little effect on the silt content at the headworks for the All-American Canal, of the size larger than will pass a 300 mesh sieve (0.05 mm openings).

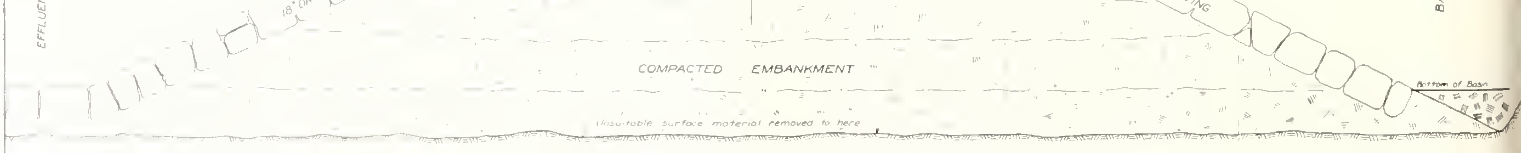
Extensive studies of the silt content of the Colorado River for more than 20 years and of the river below Boulder Dam since the completion, indicate that the clear water discharge from the dam picks up material from the river bed until the stream has become saturated with silt of the sizes available in the bed. Enough of transportable material exists in the river bed and erodible banks subject to side wash to furnish this silt load for many decades.

About 20 miles above Yuma, Ariz., on the lower Colorado River the Bureau of Reclamation has under construction the Imperial Dam to divert water into the All-American Canal on the California side of the river and into the Gila Canal on the Arizona side. The ultimate maximum diversion into the All-American Canal will be 15,155 second-feet. Immediately downstream from the Imperial Dam a mechanical desilting plant of unprecedented magnitude, a major feature of the diversion structure, is under construction. The initial installation of the desilting works is designed to remove 70,000 tons of silt per day from the 12,000 second-feet (7,756 million gallons per day) of water diverted. In the design of the plant, provisions have been made for additional units should they be required at a later date as the diversion is increased to the maximum capacity of the All-American Canal. The estimated cost of the initial installation, aside from the diversion dam, headgates and canal, is $3,500,000.

Removal of Silt

Studies indicate that after 5 years of operation more than 19 acre-feet (30,000 cubic yards) of course silt per day will enter the headgates at the diversion structure when the rate of diversion is 12,000 second-feet and may eventually reach 37 acre-feet (60,000 cubic yards) with a diversion of 15,155 second-feet. It is also estimated that the total amount of silt which will be brought into the desilting works during the first 10 years of operation will be approximately 50,000 acre-feet, and this volume may eventually be more than doubled before depletion of the available transportable material in the river bed causes a reduction of the amounts carried into the desilting works. From the foregoing the average yearly amount of silt passing the headgates during the first 10 years of operation will be approximately 8,000,000 cubic yards. Out of this amount it is estimated that the desilting works will remove 5,000,000 cubic yards per year, the removal of which, if it had been carried into the canal, would in all probability cost as much as 20 cents per cubic yard or $1,000,000 per year. (C. P. Vetter, Engineering News-Record, March 4, 1937.)

The headworks for the All-American Canal are located at the west end of the Imperial Dam and the diversion will be controlled by four roller gates, each 75 feet long and having a height of 23 feet. The main channel from the headworks structure to the desilting works is divided into four smaller channels, separated by concrete sheet-piling division walls—the two outside embankments of the main channel are of compacted earth. The inside slopes of the embankments and bottom of each channel are paved with 18-inch dry-rock paving. Each of these smaller channels, except the one nearest the river, leads from one of the roller gates to an influent channel and a combination effluent and bypass channel. The small channel nearest the river will carry water only to the combined effluent and bypass channel at the downstream end of the desilting works and is so constructed



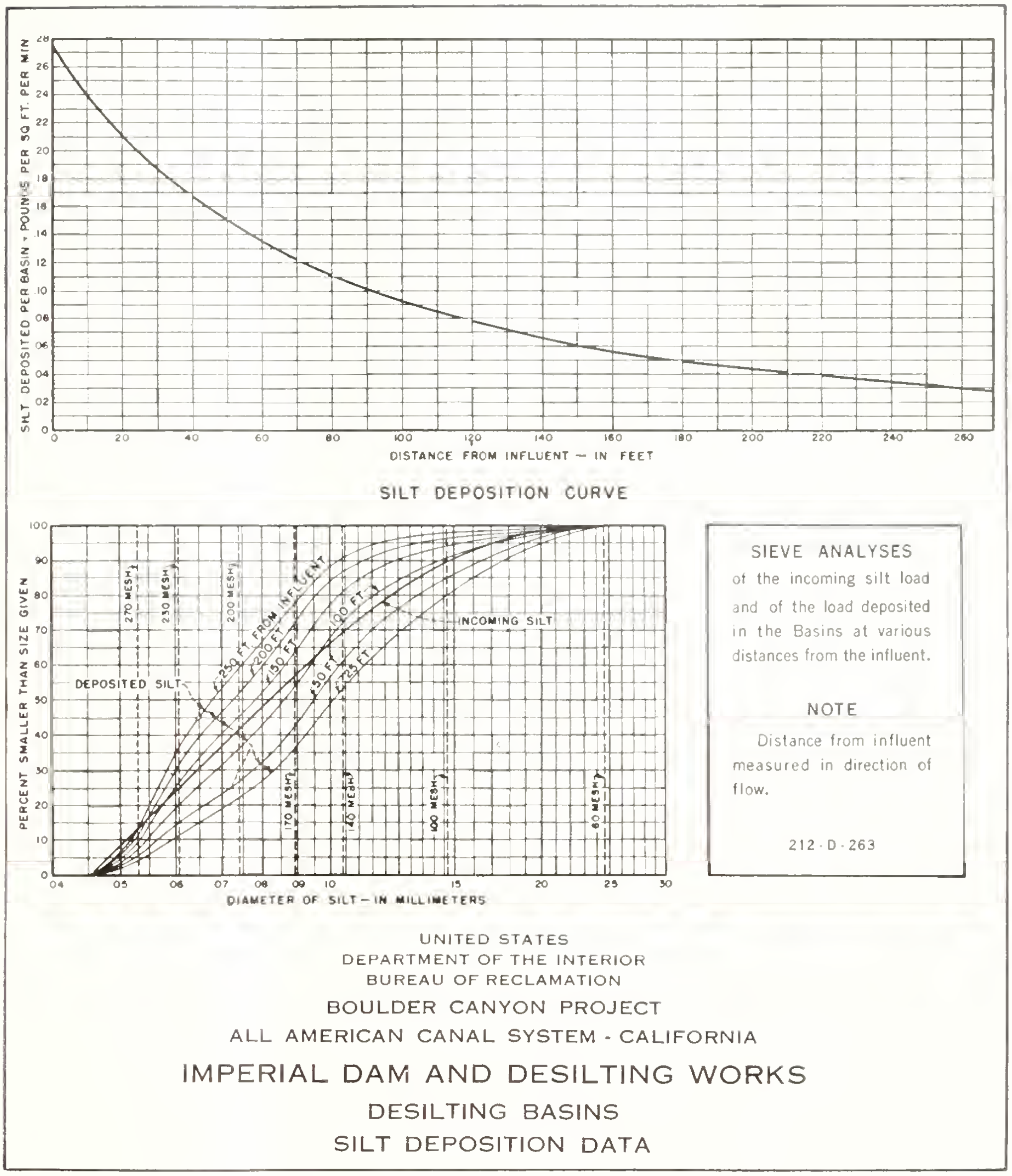
TYPICAL CROSS-SECTION OF EFFLUENT WEIR

t it will serve to carry water to additional sins should they be required at a later date.

The desilting works were built on a flat 7 section of the river bottom which was proximately 2 feet above the normal water face of the river, excepting for one hill the northwest corner of basin 1. All of division walls of the basins, effluent and pass channels, collection channels and al sections to station 50, other than the tion where excavation was required, were structed of compacted earth embankments. e selected material used in the compacted bankments was secured from a borrow pit ated about 2¼ miles northwest from the e. These embankments vary in height m 12 to 25 feet. All of the earth slopes the basins and channels are paved with inch dry-rock paving. A total of 1,100,000 ic yards of selected material was hauled m the borrow pit to construct the embank-nts and a total of 190,000 square yards of -rock paving was placed to protect the pes. The desilting works including the ious channels from the headworks at the n to the beginning of the main channel of canal, cover an area of 92 acres.

The desilting works consist of a series of settling basins arranged in pairs. Each sin is approximately 269 feet wide and 769 t long, set at an angle of 60° with the uent channels, with an average depth of 5 feet. Each basin has a rated capacity 2,000 second-feet and each pair of basins fed by an influent channel of diminishing ss-section, located between the basins. e influent channel is of concrete and the ter is uniformly distributed to the two ins by flowing through vertical slots of cial design in the walls of the channel. se slots, the tips of which are cast iron, l serve the threefold purpose of; first, re-ing the velocity and, therefore, the turbu-e of the water entering the basin; second, ributing the inflow into each of the basins formly, both as to depth and width of ins; and third, recovering nearly one-half a foot of head from the high velocity er in the channel. The water will flow oss a basin to an effluent channel leading the main channel of the All-American al. The effluent channels may also be op-ted as channels to bypass the water und the settling basins. Each influent nnel and each combination effluent and by-s channel are controlled at their junc-with the inlet channels leading from the er gates at the headworks of the dam wo 21- by 17-foot radial gates.

he water flows across each of the basins n the influent slots to the overflow weir h a maximum velocity 0.22 feet per sec-at designed capacity. At this velocity detention period in the basin is 21 min-. With this velocity and detention pe-, approximately 80 percent of the maxi-n incoming silt will be deposited on the of the basin. The efficiency of desilt-has been calculated by formula devel-



oped by the Bureau engineers and based on the studies and researches of the late Allen Hazen (Transactions, A. S. C. E., Vol. 53, 1904, p. 45). The rate of deposition of the silt as determined is shown on Drawing 212-D-263.

The design of the basins is based on a total flow of 12,000 second-feet, or 80 percent of the capacity of the canal. The estimated incoming silt load for a flow of 12,000 second-feet will be 60,000 tons (dry weight) per day with a maximum of 90,000 tons per day. Of this 90,000 tons it was further determined that 70,000 tons per day would be deposited on the floor of the settling basins, a reduction of approximately 80 percent of the maximum incoming load. The silt carried over and into the canal, 20,000 tons per day, will all be mostly finer than 0.05 mm in size and will probably be carried on through the system. A flow of 12,000 second-feet containing a silt load of 90,000 tons per 24 hours may be considered as a 0.28 percent solution, a load of 70,000 tons as a 0.22 percent, a 60,000-ton load as a 0.19 percent, and a 20,000-ton load 0.06 percent. The effluent passing to the canal will contain 0.06 percent silt, by weight, when the incoming load is 90,000 pounds and 0.04 percent when the incoming load is 60,000 tons at a flow of 12,000 second-feet. Under average conditions, 60,000 tons of silt per day, the effluent from the basins will pass to the canal 12,000 tons of silt which will be the finest portion of the incoming load.

Mechanical Removal of Silt

The silt deposited in the basins during the passage of water from the influent to the effluent channels will be removed mechanically, and as a continuous operation, by means of 72 rotary type scrapers, each 125 feet in diameter, which will move the deposited silt into collecting trenches, from which the silt will be forced into a system of sludge disposal piping

with the main sludge collector pipe in the sludge galleries. With the 6-foot hydrostatic head the sludge is forced from the collector trench through the inlet pipe, the amount of discharge controlled by the adjustable valves, and into the center well of the pedestal, thence through the discharge pipe to the main collector pipe and discharged into the sluiceway. The regulation of the valves control the volume of the flow to that necessary to maintain a solution containing approximately 10 percent silt, the maximum desired concentration. By closing the influent channel radial gates and opening the lower valves each basin may be drained for inspection and repairs to the submerged parts of the scrapers and basins.

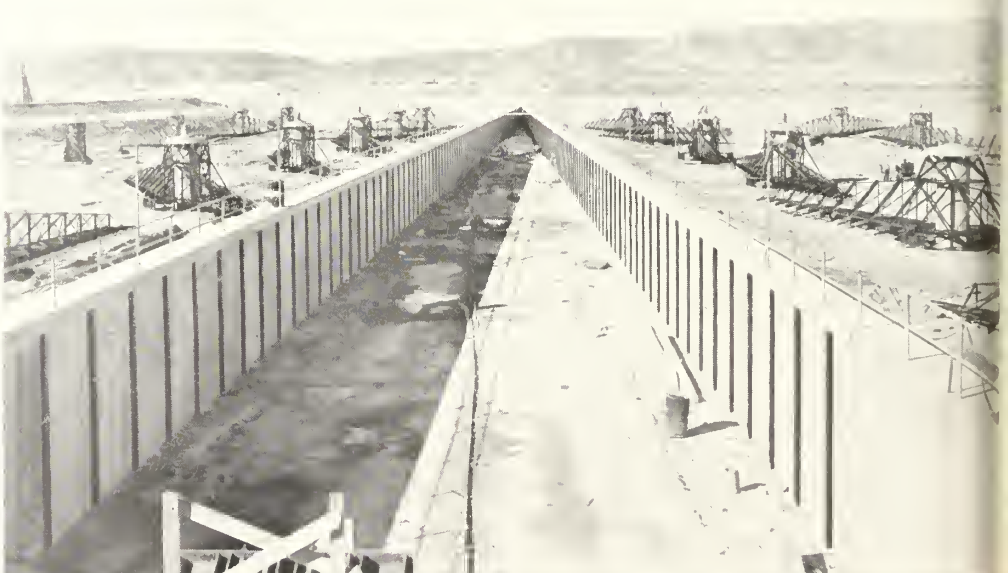
As the rate of silt deposition decreases with the distance from the influent channel the greater load of silt will be deposited on the inlet side of the basins than on the effluent (Dwg. 212–D–263). Due to this heavier load the first row of six machines in each basin is of somewhat heavier construction than the second row of six near the effluent weirs. Numerous studies, experiments, and calculations were made of the power required to move and scrape the silt into the sludge collector trench. Tests indicated that it requires 1-pound pressure to push sidewise 1 pound of silt (dry weight). Calculated power requirements were checked by models and from these studies it was determined that a 7½-horsepower motor on the larger machines and a 3-horsepower on the smaller would be required.

The supporting cage for the scraper arms is supported on a ball-bearing ring, 9 feet, 6½ inches in diameter on the large machines, and 8 feet, 5¾ inches on the smaller, with 1½-inch balls. The motors, which operate at 1,800

Bypass channel and effluent channel in foreground
Rotary scrapers and influent channel in background

and thence into the sluiceway channel leading from the sluice-gates in the Imperial Dam, from which it will be sluiced into the river below the dam. The rotary scrapers are specially designed for this type of load. Each unit has a pair of revolving trusses or arms which carry curved scraper blades, of special alloy steel, and force or "plow" the deposited silt into the central collecting trenches by blading the silt into windrows in such a manner that each row of material is successively plowed one row closer to the center upon each revolution. The trusses or arms are of the cantilever type and are supported from a central concrete pier and rotated by a central driving mechanism. These arms are triangular in cross-sectional shape, having one top chord and two bottom chords, and built of structural steel. The design of these arms includes a special feature which provides that the depth of the scraper cut be reduced in proportion to any excessive overload. The arms are hinged at the connection to the supporting cage on the driving mechanism at the ends of the diagonal member of the arms, at the top chord and the trailing bottom chord. The leading botton chord has no tensile connection with the supporting cage, but simply rests against a bearing plate in compression. Thus when a maximum load is reached, the outer end of the arm carrying the scrapers rises in a backward and upward direction in an amount to reduce the depth of cut sufficient to balance the weight of the truss with the horizontal silt load. The truss returns to the normal position as the obstruction is bladed away. V-shaped plows fitting into the circular collecting trench at the foot of the central pedestal brings the sludge (deposited silt) to the four sludge inlet pipes at the pedestals. These inlet pipes extend from the collecting trench through the outer walls of the pedestal and then rise 11 feet. The riser pipes are equipped with two flap-type adjustable valves, one in the elbow at the bottom of each riser pipe and one at the upper end, controlled by operating stems from the top of the pedestal. The upper valve opening is approximately 6 feet below the normal surface of the water when the basins are in operation. Extending through the base of the pedestal, below the inlet pipe, are sludge discharge pipes which are connected

An influent channel, rotary scrapers on each side



. p. m., are centrally located over a speed re-ucer and train of alloy steel gears to drive the rms and scrapers at 0.08 r. p. m. or 1 revolu-ion in 13 minutes. The speed at the outer nds of the arms will be 30 feet per minute.

The cylindrical pedestals and foundations hich support the rotary scrapers are of con-rete, placed on rock, cemented gravel, or on 5-, 45-, and 50-foot concrete bearing piles herever suitable foundation material was ot encountered at suitable depth. The floors f the basins are not paved, the silt being per-itted to build up to the lower edge of the crapers.

The system of sludge disposal consists of ast-iron piping, 8 and 10 inches in diameter, rom the pedestals to the main collector pipes. hese are carried longitudinally through the enter of each basin in a concrete pipe gal-ery or tunnel with an inside vertical clear-nce of 6 feet 6 inches. These galleries, six n number, each approximately 1,000 feet ong, extend under the inlet channels and em-ankments terminating in an access chamber ear the right bank of the sluiceway. The ludge pipe through the galleries are of anganese steel varying from 14¾ inches in iameter at the upper end to 36 inches at e outlet end. The sludge, a solution of 10 ercent silt concentration, will flow through hese pipes at a velocity of 6 feet per second nd no undue erosion of the pipe is expected nder these conditions.

Operation of Sluiceway Channel

The sluiceway channel along the east or iver side of the desilting works, with rock-lled dikes for bank protection, has been uilt to carry the normal excess flow of the iver, not required for irrigation. The silt emoved from the desilting basins is dis-harged into this channel and transported own the river by the surplus water. Some 000 second-feet is the quantity estimated s necessary to transport the silt and this calculated to be available for many years.

The effluent weirs at the sides of each pair f settling basins, over which the desilting water passes to the combination effluent and bypass channels and thence to the canal, are of compacted earth fills, capped with reinforced concrete with aprons of the same material, extending a short distance down the slopes on each side of the fill; the remaining portion of the slopes are covered with dry-rock paving. The crest is of 6- by 12-inch timbers, set in a recess in the concrete, adjustable for minor variations in height.

Each effluent channel is so arranged that it may be used as a bypass for the diversion of unclarified water around the settling basins and directly into the canal. Thus, in case of breakdown of the scraper mechanisms, or for other reasons, the canal can be operated without the desilting works.

The operation of the mechanical scrapers and the radial gates at the head of influent and combination effluent and bypass channels are controlled from a main control house located on a hill top near the California abutment of the Imperial Dam. There are also basin control houses, located on the embankment at the upper end of each pair of settling basins.

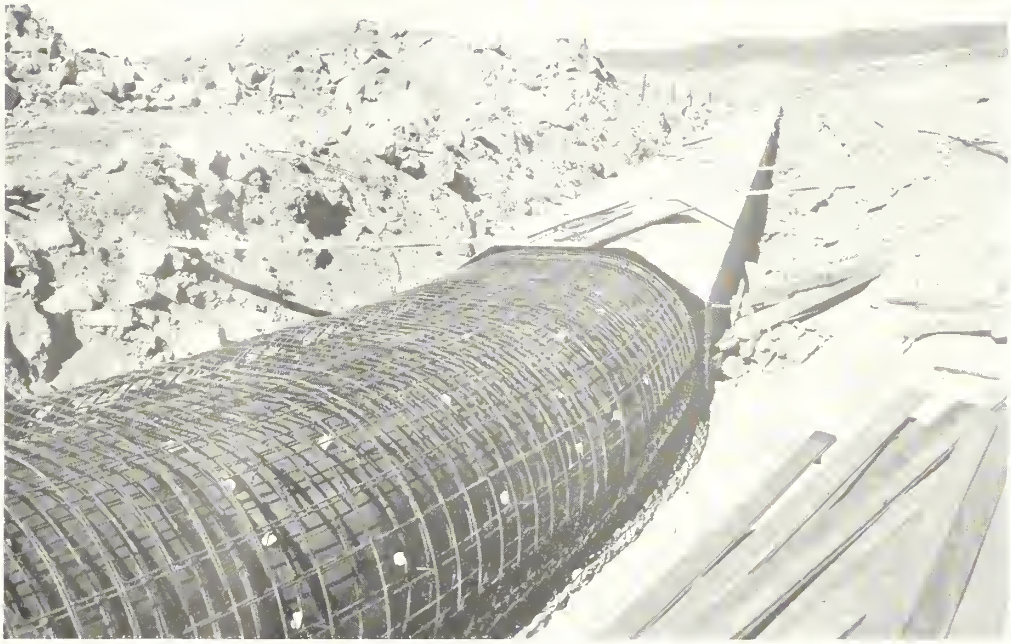
Power

The incoming power supply to the main control house is 2,300 volts, entering a switchboard with seven manually operated oil circuit breakers in separate compartments. A gasoline-engine-driven generator provides an emergency source of power suffcient to operate the various gates of the headworks and desilting basins, in case of failure in the main supply. Three of the oil circuit breakers feed out-going power circuits to the three pairs of desilting basins. These feeders are run through tile ducts to the basin control houses. Each basin control house has a 2,300-440-volt three-phase transformer to feed the 24 scraper motors and a 2,300-110-volt transformer to supply control power. The feeders from the transformers are connected to the basin control boards, and from this board to the sludge galleries, and thence underground in conduits to the different scraper units. All power cables are lead covered.

Control of Scraper Mechanisms

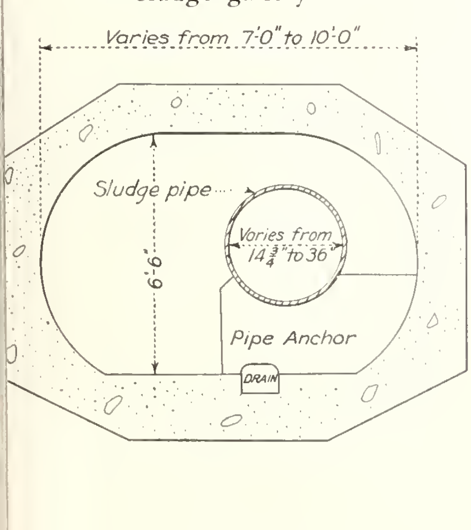
Three methods are provided for controlling the scraper mechanisms. First: They can be started and stopped individually by push-button switches on the basin control house board. Second: A master-control switch on the basin control house board starts four of the scrapers at a time, in sequence, and a master stop push-button switch will stop all the scrapers in the basin. Third: A "start" push button on the main control house board operates the same sequence starters and a similarly located "stop" push button will stop the scrapers in each basin. The control for each basin is identical.

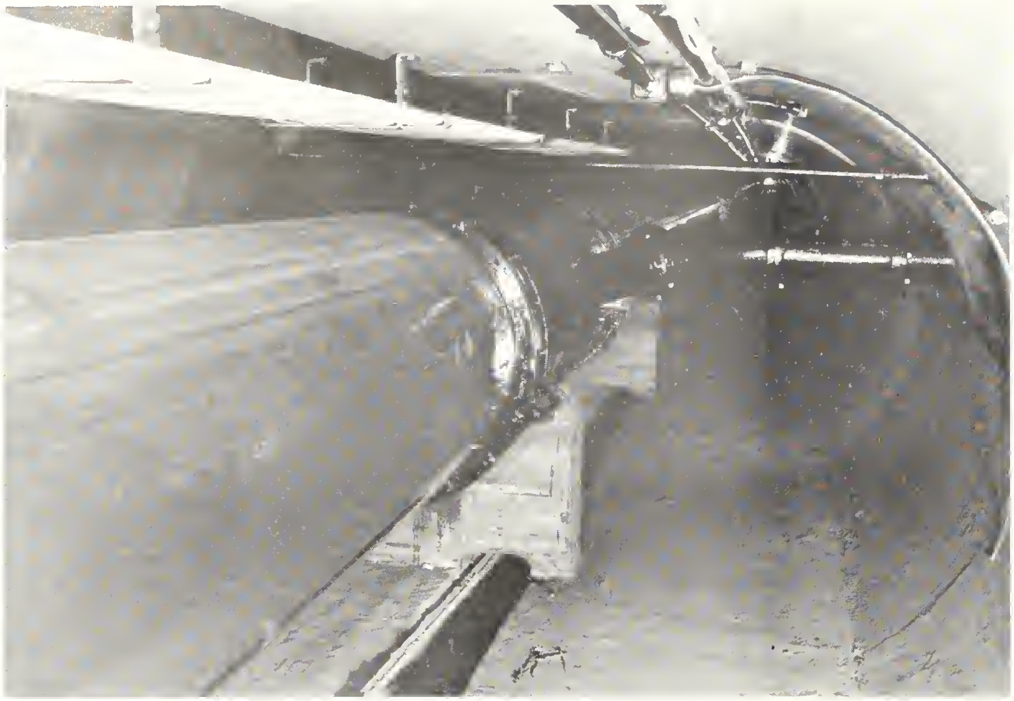
Each rotary scraper is protected from overloading by two "overload" relays in the motor feeder lines, one which gives an alarm when the motor is slightly overloaded, the other which disconnects the motor if a heavy overload occurs. The alarm relay operates a bell at the basin control house, lights a red light on the scraper mechanism, and a white light near the individual motor switch on the basin control house board. This relay is for alarm only and will not stop the scraper.



Sludge pipe gallery under construction

Typical cross section of sludge gallery





Interior view of sludge gallery

The overload relay is set at 125 percent of full load current and opens the motor contactor, stopping the motor when this loading is reached. Whenever this motor contactor opens, the red light on the scraper mechanism and a white light by the motor switch on the basin control board come on and a "howler" on the roof of the basin control house sounds. In addition to these controls a float switch is mounted inside each pedestal, which supports the rotary mechanisms. This switch operates the red light on the mechanism, the white light by the motor control switch, and the bell at the basin control house. This float switch operates when the water surface rises inside the pedestal, indicating that the sludge outlet has become plugged. The heavier scrapers, nearest the influent channel, have an additional overload switch which operates when the scraper arm is forced to raise. This switch operates the same lights and bell as the float switch in the pedestals, but only intermittently—once each revolution of the scraper. When any one of the above mentioned relays or switches operates, a "howler" at the main control house sounds, lights on the main control board indicate in which basin the trouble occurs, and also whether the scraper is stopped or overloaded.

The influent and the bypass gates at the upstream end of each channel may be operated from three points: first, by push-button switches on the control cabinets on the gate structure; second, by control switches on the basin control switchboard; and third, by control switches in the main control board at the main control house. The position of the bypass gates is shown on indicators on both the basin control and main control boards.

Water level indicators in the main control house show the water surface in the inlet channels, in each basin, and in the main channel of the canal, a short distance downstream from the desilting works. The water level of the individual inlet channels and each pair of basins is also indicated in each basin control house.

The All-American Canal project, of which the Imperial Dam and Desilting Works are a part, is being constructed under the direction of the Bureau of Reclamation. The cost of the system has been contracted to be repaid by the Imperial Irrigation District and the Coachella Irrigation District of California. The construction contract for the Imperial Dam and the Desilting Works, Bureau Specifications No. 644, was awarded Morrison-Knudsen Co., Utah Construction Co., Winston Bros. Co., known during construction as "M-U-W." The rotary scraper mechanisms and their electrical controls were furnished, under Bureau Specifications No. 635, by the Dorr Co., Inc., who, under the specifications also furnished the detail designs.

Effluent weir cap under construction

Farm Security Administration Active on Milk River

DEVELOPMENT of Milk River project lands by the Farm Security Administration has progressed at a rapid rate in order that all work possible could be accomplished during the fiscal year 1938. Practically all of the farm units developed are in production this season and the crops now in prospect are among the best on the project.

Minidoka Dairyman Wins First Prize

THE report of the Gooding-Jerome cow testing association for May, showed that the herd of Joe Gisler, of Rupert (Minidoka project), Idaho, containing 17 cows, again won first place with an average yield of 1,472 pounds of milk and 48.7 pounds of butterfat per cow.

Progress of Investigations of Projects

Arizona-California, Colorado River surveys.—Preparation of the mosaics from aerial photographs from Boulder Dam to Topock and from Parker Dam to Mexican boundary and along the Gila River is in progress.

Colorado, Blue River transmountain diversion.—Revision of designs and plans for Waterton, Two Forks, Box Elder, Ute Park, and Stronia Dams was in progress.

Colorado, eastern slope surveys.—Flood-control studies of Cherry Creek were continued and reports of Hugo and Chivington projects nearly completed.

Colorado, western slope surveys.—Studies were continued of the Collbran, Florida, La Plata, Paonia, and Silt projects.

Idaho, Cabinet Gorge project.—Power studies were continued and preparation of designs of dam at Cabinet Gorge site begun.

Southwest Idaho investigations.—Diamond drilling was continued at Twin Springs site and project placed on construction basis; report of storage possibilities in Payette River Basin in progress; flying and photographing of Mountain Home area was completed.

Idaho, Snake River storage.—Drilling was continued at Narrows dam site and geologic studies about completed at Burns Creek and Grand Valley dam sites.

Montana, Marias project.—Survey of canal lines was continued and classification of lands in the project area was begun.

Nebraska, Bostwick project.—Report of the project was completed.

Oklahoma, Fort Supply project.—Surveys of canal lines for Mutual and Moscow Flats about completed, and study of water supply from North Canadian River continued.

Oklahoma, Kenton project.—Report of project is practically completed.

Oregon, Canby project.—Report completed.

Oregon, Goose Lake Valley project.—Report on a preliminary investigation of project was completed.

Oregon, Grande Ronde project.—Surveys of Little Minam River and Little Indian Creek dam sites were completed and preparation of report of project begun.

Oregon, Medford project.—Drilling of South Fork and Lake Creek dam sites completed and geologic report made; topography and canal surveys nearly completed.

South Dakota, Angostura project.—Report of project nearly completed.

Utah, investigations.—Surveys and studies were continued of Gooseberry and Scofield Reservoirs; Price River pumping plans, and classification of lands on the Ogden East Bench lands along Weber River are in progress.

Utah-Idaho-Wyoming, Bear River project.—Preparation of the aerial mosaic was continued and surveys of the Neponset and Woodruff Narrows were in progress. Reservoir sites along Smiths and Thomas Forks and in Twin Creek Basin were inspected.

Colorado River Basin surveys.—Land classification maps of Price River and Clark Valley areas were completed; inspection of Price River, Clark Valley, San Rafael River, Thompson-Cisco and Dolores projects made. Collection of data regarding water requirements in the Green River Basin was continued.

Anti-Noxious Weed Board Active[1]

IN A recent article we spoke of the necessity, as the time approaches that the weed battle should become Nation-wide in scope, that methods of attack should become uniform, the expense should become the smallest possible and the economic results should be the largest. The one national publication that we have regular access to is the RECLAMATION ERA. In the June number, just received, is nearly a two-page article by W. H. Mercer of the Uncompahgre Valley Water Users' Association. As the ERA is accessible to all of our readers, we ask them to give this article particular attention.

This is followed by another article telling of the formation of a bindweed (wild morning glory) district in Mitchell Valley, Scotts Bluff County, Nebraska. This is by C. W. Nibler, farm agent of that county. Readers will note that the confining of this organization to only one weed is rather unique.

Poison Hemlock

Now, let us call the attention of our readers to something that is very important because it strikes nearer home. On boarding the train last Friday night at Phoenix on returning from the river conference of the 22d and 23d of June, we found lying on the seat a copy of the Tucson Daily Citizen of June 24. On page 2 we found a half column article headlined, "Thornber urges fight against poison hemlock." All will recognize that this is our vigilant State botanist of the University. It seems that it is not enough to be bothered with weeds that smother crops, but we must also be handicapped with plants that poison our livestock. A copy of this article should be in every farmer's handbook.

Poison hemlock is described as far more dangerous than the loco weed that is known throughout the Southwest. The region that is affected is a 25-mile stretch along the Gila River in Greenlee County near the town of Duncan. The plant will not flourish on the dry desert, as there must be plenty of water, such as along the canals of an irrigation project. At present let us rely on the fact that the zone is above the San Carlos Dam and the seed must pass that project before it reaches the part of the Gila where the water on the surface comes in contact with and finally reaches the land watered by the Colorado.

Thus, we can begin to see the task there is before the farmers in this region where a river can flow along, then dodge and move underground to be reached only by pumping, as in the Santa Cruz, then again mount to the surface clear and crystal to join the surface water farther down the stream. Seeds, however, will not follow the subterranean spring courses and will move only in flood conditions during the heavy rain season.

It is likely that a bulletin will be prepared that will give all the available information relative to this dangerous water hemlock, that now appears to become serious in the upper Gila Valley just across the Arizona line. Let us all be vigilant in watching for this enemy.

Respectfully,

R. H. THEILMANN,
FELIX SEGULA,
JOE D. TURRENTINE,
Directors, Anti-Noxious Weed Board.

[1] From Yuma Daily Sun.

Leveler-Float Drawing Available

REPRINTS of the drawing for the one-man operated leveler float with the accompanying article explaining its use, which appeared in the April issue of this magazine, are now available and may be obtained by writing the Commissioner, Bureau of Reclamation, Washington, D. C.

Most irrigated farms have some land that can be improved by leveling and smoothing. This grading not only adds to the value of the farm but makes irrigating easier and more efficient, reduces waste of water, and insures a more uniform crop harvest.

On many farms a one-man operated leveler float will be found a useful implement for this work. Whether tractor or horses are used, this leveler-float can be operated by one man. This equipment is inexpensive and can be constructed by any handy farmer with a small amount of assistance from his blacksmith. The drawing gives the plan for the one-man operated leveler float, description of the material required and sufficient information for constructing the implement.

The reprints are available not only to individual irrigators desiring to build a leveler float for their own use but also to irrigation superintendents, county agents, agricultural instructors, and others who may wish copies for distribution to interested farmers.

Construction of the World's Highest Multiple Arch Dam

By W. A. DEXHEIMER, *Field Engineer*

THE world's highest multiple arch dam and the first major structure of this type to be built by the Bureau of Reclamation is nearing completion. Bartlett Dam, located on the Verde River, 54 miles by road northeast of Phoenix, Ariz., will provide flood control and storage for waters of Arizona's most dangerous and unpredictable river.

The foundation rock for the lowest arch is at elevation 1,513, 92 feet below low river level, and the 4-foot walkway across the top of the dam is elevation 1,799.5, making the dam 286.5 feet in height. The top of the parapet wall is 1,803 feet in height, and the length along the axis, excluding the spillway, is 740 feet.

The next highest multiple arch dam is at Lake Pleasant on the Agua Fria River within 50 miles of Bartlett Dam and 256 feet in height.

The 200,000-acre-foot reservoir will provide additional irrigation storage for Indian lands and the highly productive Salt River Valley, utilizing existing canals and diversion works of the Salt River project below the junction of the Verde and Salt Rivers. No power development is contemplated.

The dam consists of 9 hollow concrete buttresses with a gravity section at each end and 10 reinforced concrete arches. The buttresses have an 8-foot constant space between walls and taper on their outside faces. They are spaced at 60-foot centers measured along the chord at the axis of the dam, which has a radius of 1,379.7 feet. Radial buttresses tapering in thickness provide a constant 48-foot span for the arches from the base of the dam to the top. Each wall or "leg" of the buttress at the upstream end has the same thickness as the normal arch at the corresponding elevation and varies uniformly from 7 feet at elevation 1,540 to 24 inches at elevation 1,795.5. Lines of uniform thickness slope 1.64 : 1 from the upstream to downstream end of buttresses. Vertical, sawtooth contraction joints are spaced at 41-foot 6-inch centers along the buttresses and are filled after the heat of setting has been dissipated—a minimum of 15 days after adjacent concrete is placed. Each 41-foot 6-inch section of buttress has two 18-inch vertical stiffener walls between sides.

Top of arches are below river level

Steel Forms

The arches are a 180° segment with a constant radius of 24 feet at the intrados normal to the 0.9 slope of the buttress face and variable radius at the extrados to allow for changes in thickness. The arches are placed in lifts of 15 feet measured along the slope. There are no expansion or contraction joints.

Steel forms are being used for both buttresses and arches. Buttress panel forms for 10-foot lifts are raised by a fixed tower cableway of 10-ton capacity with an 1,140-foot span. Drift lines to tractors provided with hoists were used for upstream and downstream movement of the cableway hook during construction in the river bed. Later, two cables were strung parallel to the main cableway approximately 200 feet upstream and downstream. These cables carry drift lines operated by separate hoists which replaced the tractors. The upstream and downstream end forms of buttresses and contraction joint forms are made of small steel panels and reassembled for each lift to provide for variable buttress widths.

Intrados arch forms are carried on tracks fastened to the sides of buttresses with cone bolts and are raised with a hand hoist on each track and an A-frame and hoist set up at the crown for each move. The A-frame rests on top of the arch concrete and is guyed to bolts in the upstream face of the arch. Jacks integral with the forms provide adjustment and clearance for moving.

The extrados forms are carried on tracks fastened to the buttress face slab with plates and are raised in the same manner as intrados forms. Small segments are removed,

ach lift to conform to changes in circumference of the arch barrel.

River diversion is through a natural chanel on the left side and between two butresses. The arch between these buttresses s omitted during diversion. A gravity type raining wall 200 feet long connects the ownstream end of the buttress on the right f the diversion channel to a rock "island". temporary bulkhead extends from the uptream end of the same buttress to another ock "island" providing a channel of approxiately 10,000 second-feet capacity. A cofferam parallel to the river gave initial access or construction of buttresses and training vall forming the diversion channel.

The arch closing the diversion or outlet hannel contains three 7 foot 6 inch by 6 foot lide gates. While these gates and arch are eing placed the river will be diverted over he arch in the center of the dam which was onstructed only to original stream bed elevaion. This arch will be completed after the iver is again diverted through the outlet hannel.

In addition to the three slide gates there re two 72-inch diameter outlet pipes through he center of one buttress slightly higher than he slide gates. Normal flow from the reseroir will be through these outlet pipes and ontrolled by 66-inch needle valves at their ownstream ends, the slide gates being used nly at low reservoir level. Trashrack strucures protect the intake ends of all outlets.

Foundation rock is good, fine-grained granite with abundant jointing generally parallel o the river and nearly vertical. The joints re tight or close beneath the weathered urface and compactly filled with products f alteration. Downstream from the axis f the dam is an unusually coarse-grained ranite which also underlies the lower half f the spillway channel. The contact of fine nd coarse-grained granites is transverse to he canyon and well fused. Except for aproximately 40 feet of the two longest butresses in the river gorge, the dam foundaon is entirely in the fine-grained granite. oth varieties provide entirely adequate suport and imperviousness.

Fault Zones

Two fault or shear zones cross the canyon early at right angles to the buttresses and ownstream from the arches. These zones, rying in width from ½ inch to 30 inches, p at approximately 77° upstream and are mpactly filled with sheeted and crushed ck and altered materials. The jointing and ulting are not considered detrimental to e foundation except as possible paths of rcolation from the reservoir.

The fault zones near the upstream face of e dam are excavated to firm rock or until e zone pinches out to 6 inches in width. his zone is back-filled with concrete and outed to a depth of 25 feet below the excavation. In addition, shafts are being sunk into the fault zones where they pass under the upstream face of the dam high up on the abutments. The shafts will have a minimum depth of 25 feet, keyed into adjacent firm rock, and filled with concrete to prevent percolation through the fault zone.

Grouting the foundation, in addititon to the special treatment of faults, consists of a single curtain of holes on 5-foot centers at the upstream toe of the arch cut-off trenches, alternate holes being 75 and 100 feet deep. Secondary grouting 25 feet deep with holes at 5-foot centers was also done at the upstream end of each buttress just downstream from the primary grout curtain. Diamond drilling and grouting was done through 2½-inch pipes caulked 18 inches into foundation rock and embedded in the cutoff concrete.

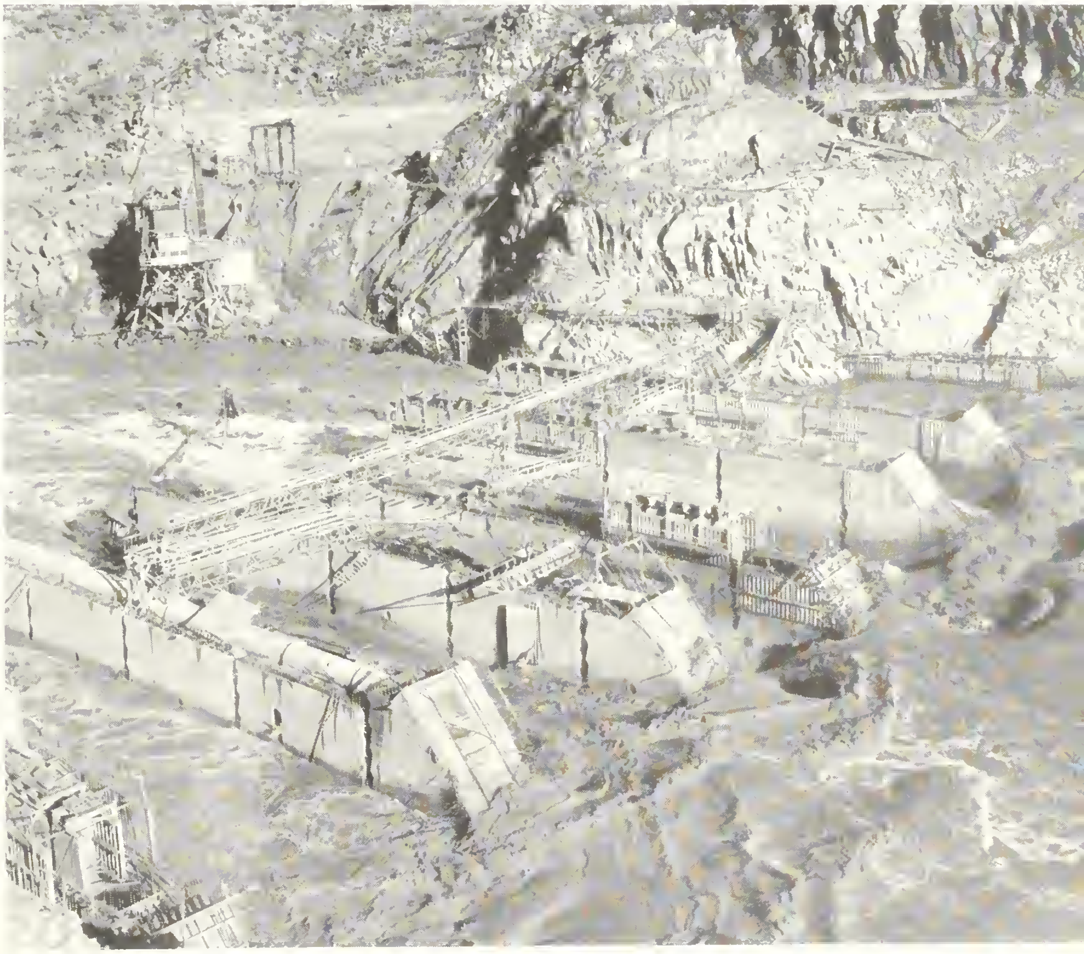
Nearly horizontal jointing in parts of the foundation necessitated drilling and grouting by stages to secure adequate impregnation and sealing near the surface. Within prescribed areas all holes were drilled to a 10-foot depth, then grouted to that depth. Alternate holes were then drilled in the next stage to 40 feet in depth and grouted at that depth, then to 70 feet, and finally to 100 feet. Intermediate holes were generally drilled and grouted from their initial 10-foot stage to final 75-foot depth in one operation.

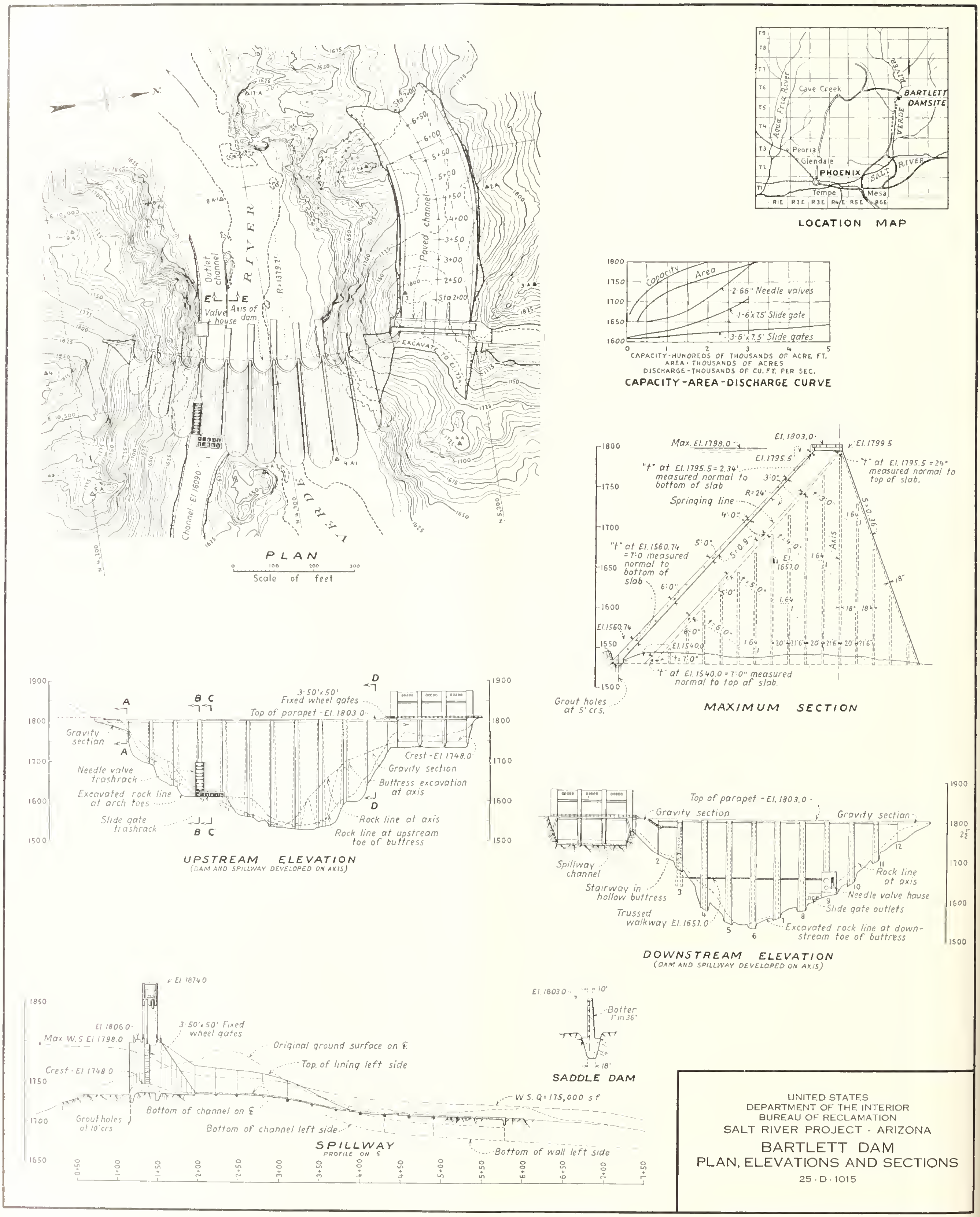
Precise leveling was carried on continuously during grouting operations so that any uplift in the arches, buttresses, or adjacent rock could be immediately detected. Grouting pressure was reduced or grouting temporarily discontinued, as conditions warranted, when occasional uplift of two to eight thousandths of a foot occurred, to prevent undesirable stresses in arches or buttresses and the possibility of cracking. Grout mixes and pressures varied, but ordinarily a mix of 3 parts water to 1 part cement was used. Pressures varied from 50 to 350 pounds per square inch. Grout consumption averaged 1.3 sacks of cement per foot of hole after deductions for waste.

Uses of "Pumpcrete" Pipe

Concrete in the river bed was hauled by truck in 2 cubic yard buckets from the mixing plant and placed by a traveling crane. Except for the lowest parts of the dam, all concrete is transported from the central batching and mixing plant through an 8-inch "Pumpcrete" pipe to hoppers and distributed

Flood of March 4, 1938




LOCATION MAP
BARTLETT DAMSITE
Cave Creek
Agua Fria River
VERDE RIVER
SALT RIVER
Peoria
Glendale
PHOENIX
Tempe
Mesa
CAPACITY-AREA-DISCHARGE CURVE
Capacity
Area
2-66" Needle valves
1-6'x7.5' Slide gate
3-6'x7.5' Slide gates
CAPACITY-HUNDREDS OF THOUSANDS OF ACRE FT.
AREA-THOUSANDS OF ACRES
DISCHARGE-THOUSANDS OF CU. FT. PER SEC.
PLAN
Scale of feet
VERDE RIVER
Outlet channel
Valve house
Axis of dam
Paved channel
EXCAVATE TO El. 1734
MAXIMUM SECTION
Max. El. 1798.0
El. 1803.0
El. 1799.5
Springing line
Grout holes at 5' crs.
UPSTREAM ELEVATION
(DAM AND SPILLWAY DEVELOPED ON AXIS)
3-50'x50' Fixed wheel gates
Top of parapet - El. 1803.0
Gravity section
Needle valve trashrack
Excavated rock line at arch toes
Slide gate trashrack
Crest - El 1748.0
Buttress excavation at axis
Rock line at axis
Rock line at upstream toe of buttress
DOWNSTREAM ELEVATION
(DAM AND SPILLWAY DEVELOPED ON AXIS)
Spillway channel
Stairway in hollow buttress
Trussed walkway El. 1657.0
Needle valve house
Slide gate outlets
Excavated rock line at downstream toe of buttress
SPILLWAY
PROFILE ON ℄
Original ground surface on ℄
Top of lining left side
Bottom of channel on ℄
Bottom of channel left side
Bottom of wall left side
Grout holes at 10' crs
SADDLE DAM
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
SALT RIVER PROJECT - ARIZONA
BARTLETT DAM
PLAN, ELEVATIONS AND SECTIONS
25-D-1015

by buggies. The concrete in the lower half of the dam was placed with the mixer discharging directly into the Pumpcrete machine. The upper half of the dam and spillway are being placed with the pump on the right abutment and about 30 feet below the top of the dam. Concrete is transported from the mixer to the Pumpcrete in 2 cubic yard bottom-dump buckets on an inclined shuttle cableway.

The "Pumpcrete" is a duplex piston pump, fed from a hopper directly above the valves. It forces concrete through a "Siamese" connection to the single 8-inch pipe. The pipe is in standard 10-foot lengths with a variety of bends and is readily assembled to meet required alignment. Rubber gaskets at each joint prevent mortar loss and air locking. When concrete placing is near completion for the day, the placing foreman computes the amount of concrete in the pipe line (1 cubic yard per 87 feet of nominal 8-inch pipe). When the concrete in the pipe line equals the estimated amount to complete placing, the line is broken at the "Pumpcrete" and a "Go-devil" inserted.

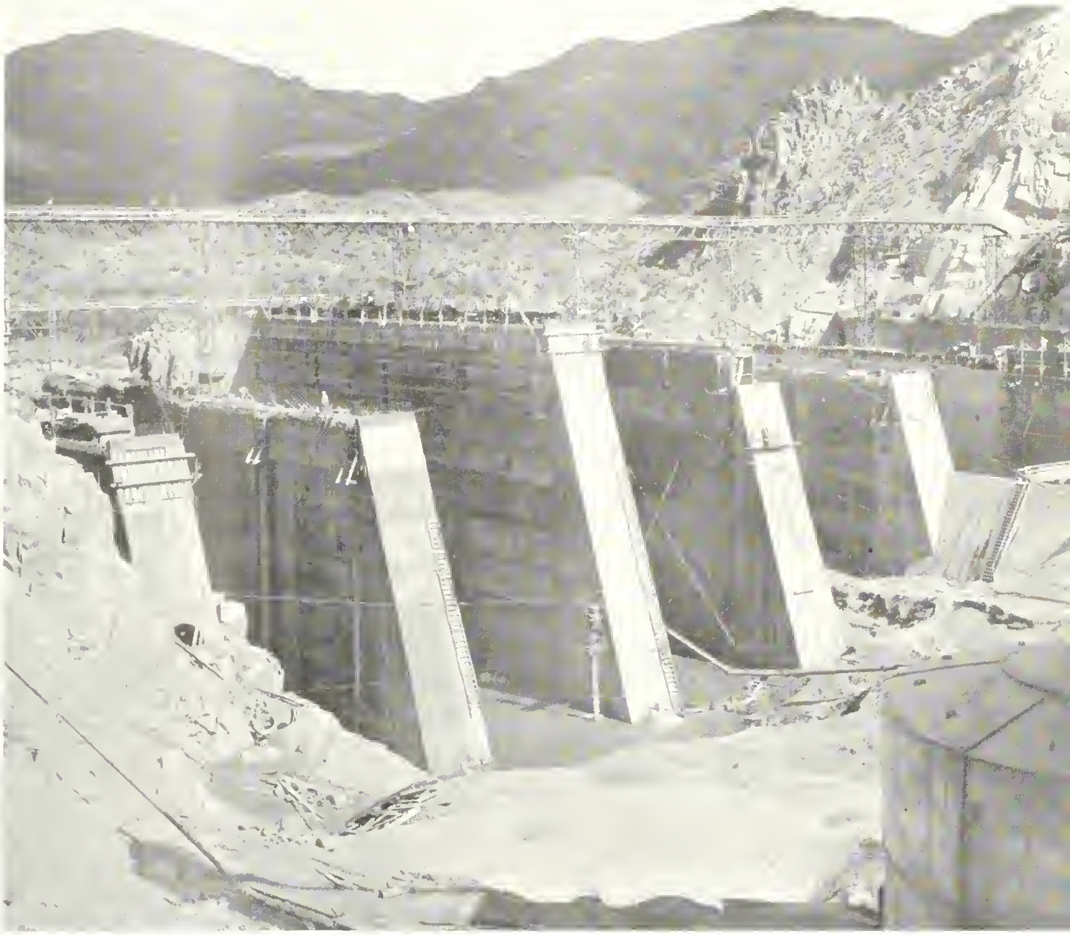
This "Go-devil" consists of tightly rolled burlap about 16 inches long which fits the inside of the pipe and pushes the concrete ahead of it. A special head is clamped on the pipe line in place of the Siamese connection and the concrete and "Go-devil" forced through either by water or air pressure, leaving the pipe clean and ready for the next placing operation.

During extreme hot weather, the "Pumpcrete" pipe lines are wrapped with two layers of burlap and sprinkled to eliminate heating and drying of concrete. Concrete has been delivered at the forms cooler than at the mixer with this method and with air temperatures well over 100° F.

The pipe line is carried on steel box trusses spanning between steel towers set in each buttress high enough to allow placing four 10-foot lifts. When this 40 feet has been placed in each buttress the towers and trusses are raised for the next four 10-foot lifts.

A maximum of 50 cubic yards per hour has been placed with the "Pumpcrete" and the maximum lift has been 45 feet. Using accepted allowances for bends and vertical lift, concrete has been pumped a maximum equivalent to 1,300 feet of horizontal pipe line.

The spillway to the right of the right abutment will have a capacity of 175,000 cubic feet per second and is of unusual design. Exhaustive model studies led to the adoption of a curved and superelevated discharge channel with a raised lip or "bucket" at the downstream end of the paving. The floor of the channel is 170 feet wide and has a maximum superelevation of 45 feet. The concrete-lined channel ends in the coarse-grained granite previously mentioned which is partially disintegrated at this higher level, but a cut-off wall extends below this into firm rock. To avoid erosion under or at the end of the concrete paving the water is "jumped" off the end of the raised lip or "bucket". Beyond that point erosion may occur without affecting the structure.



View from downstream

Discharge will be controlled by three 50- by 50-foot counterbalanced regulating gates with hoists operated by 230-volt, direct-current motors. Prime power will be from gasoline engine generator sets.

Power for construction is purchased from the Salt River Valley Water Users' Association and transmitted over 16 miles of 44,000-volt line built by the contractor. This line will be abandoned on completion of the dam. Because of the 25-cycle frequency, two converters with a combined capacity of 1,200 kilowatts were installed at the dam for 60-cycle power to operate construction equipment and furnish light.

All equipment and materials are hauled by truck from the rail head at Phoenix. Cement is shipped in bulk, unloaded into a storage silo, then transported to the 2,000-barrel silo at the dam in tank trucks and trailers of 8- and 12-ton capacities.

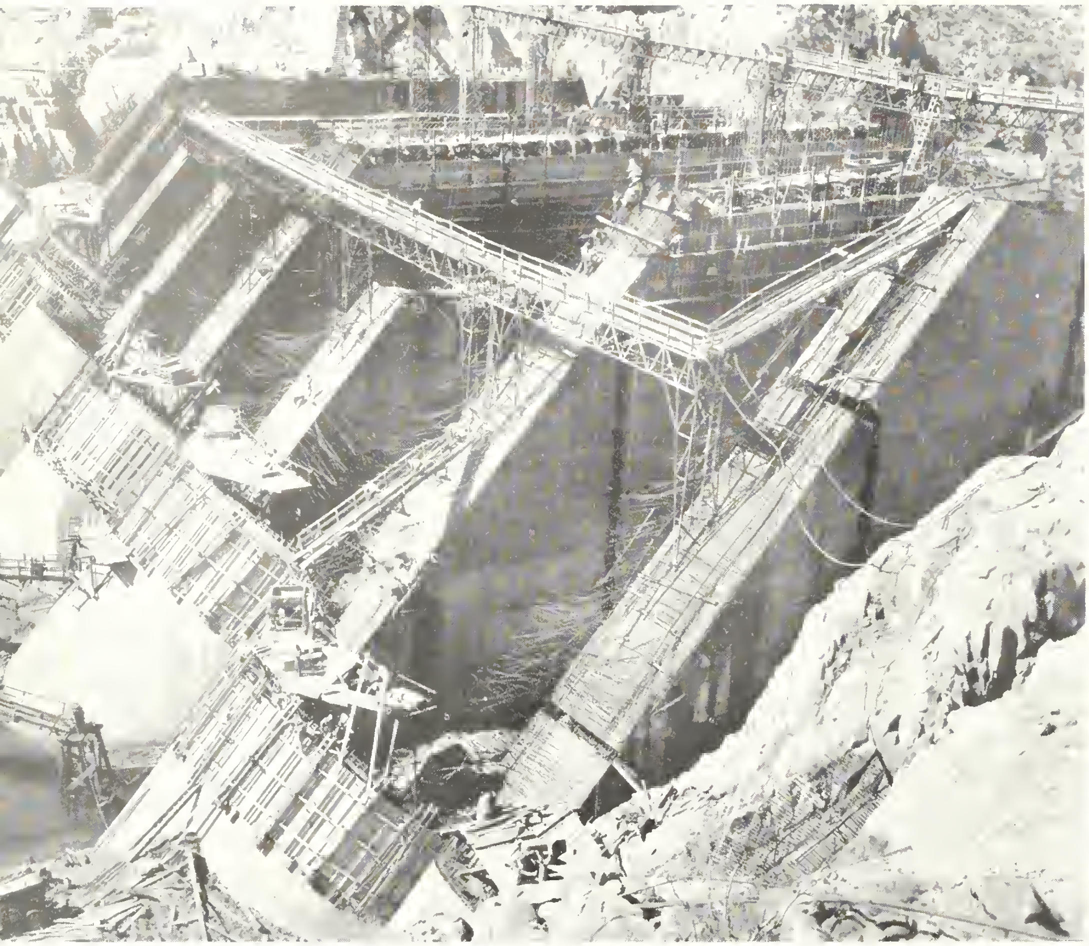
Aggregate and sand are obtained from a pit one-half mile downstream from the dam and washed, screened, and stock piled near this pit. Approximately 30,000 cubic yards of fine blending sand hauled from a pit 2 miles farther downstream were required to obtain correct sand grading.

A unique method is used for recovery of processessed aggregates. Three hundred feet of steel forms used by the contractor on Metropolitan Aqueduct siphons were set in a shallow trench forming a horseshoe tunnel beneath the stock piles. Openings were cut through the steel forms and provided with chutes so that trucks drive through the "tunnel," load under the desired chute, and haul aggregates to the hoppers above the batching and mixing plant.

Low-heat portland cement is used throughout the dam with the exception of sacked cement for grouting and a small amount of modified portland cement purchased at the beginning of concrete placing. The objective of the designers was to obtain a structure as nearly monolithic as practicable, of adequate strength and durability at minimum of cost. With the innovations in design of Bartlett Dam, proper reinforcement, use of low-heat cement and accurate control of concrete batching, mixing, and placing, it is believed this objective has been attained.

Work Delayed by Floods

Several floods of unusual magnitude have delayed the contractor and caused large losses. The most recent one on March 4,



View showing construction of arches

1938, peaked at 92,700 cubic feet per second and overtopped parts of the structure without damage. Another flood on February 7, 1937, peaked at 62,500 second-feet. Both of these floods destroyed all cofferdams, stopped work in the bottom of the canyon and resulted in serious delay and loss of materials and equipment.

Other floods of lesser magnitude have caused delays and losses, coming with very little warning. The Verde River drains 5,600 square miles above the dam site which varies from semitropical desert to high mountains and is subject to torrential desert rains in the lower reaches and heavy snowfall in the mountains.

The contract for construction of Bartlett Dam was awarded to the Barrett & Hilp and Macco Corporation of Clearwater, Calif., on July 3, 1936, on their low bid of $2,228,-272. Eight bids were received. The dam is scheduled for completion on May 9, 1939.

Articles on Irrigation and Related Subjects

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Well points used to dewater excavation for power drop on All-American Canal, illus., Southwest Builder and Contractor, June 24, 1938, Vol. 91, p. 17.

Novel concreting plant at Pilot Knob, illus. and cover, Engineering News-Record, June 30, 1938, Vol. 120, No. 26, p. 896.

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American Standards Year Book for 1938. American Standards Association, 29 West 39th Street, New York, 80 pages.

Averill, Walter A.

Max J. Kuney Co. solves world's worst grouting problem at Island Park Dam, illus. Pacific Builder and Engineer, July 2, 1938, Vol. 44, No. 27, pp. 36–42.

Bruhn, H. D.

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Columbia Basin—Grand Coulee Project

The Columbia Basin—Grand Coulee Project, illus. Spokane Chamber of Commerce, Spokane, Wash., May 1938, 40 pages.

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Safety publication issued semimonthly by the Consolidated Builders, Inc. Mason City, Wash., Todd Woodell, managing editor, first number of Vol. IV issued June 16, 1938, mimeographed. 12 pages.

Connell, P. J.

Control structures for Kingsley Dam, illus. Engineer, Central Nebraska Public Power and Irrigation District, Colorado Engineers Bulletin, July 1938, Vol 22, No. 7, pp. 5–6 and 19.

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Deer Creek Dam

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Dill, David Bruce

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Earthfill dam to be built on Lower Colorado River, map. Western Construction News, June 1938, Vol. 13, No. 6, pp. 239–240.

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Hinds, Julian

Large delivery lines for the Colorado River Aqueduct System, illus. Civil Engineering, July 1938, Vol. 8, No. 7, pp. 469–472.

Larson, Sidney D.

Analyses of proposed designs for Marshall Ford Dam. Technical Memorandum No. 573, May 15, 1938, 69 pages, numerous charts. Price $3.50.

Gravity analyses of proposed design for Shasta Dam, charts. Technical memorandum 575, charts, 38 pages. Price $2.

Mitchell, L. H.

Practical use of soil and water, mimeographed lecture, 1938, 42 pages (# 17,516). Free distribution.

Nelson, Wesley R.

Ornamental features of Boulder Dam, illus. Compressed Air Magazine, June 1938, Vol. 43, No. 6, pp. 5615-5620.

North Platte Diversions

Statement by A. A. Edwards, included by Hon. Fred Cummings in Congressional Record, June 15, 1938, Vol. 83, No. 123, pp. 12414-15.

Page, John C.

Boulder Dam—Power and Play, illus. American Forests, July 1938, Vol. 44, No. 7, pp. 294-298.

Shasta Dam

Pacific Constructors low bidders on Shasta Dam at $35,939,450, illus. Pacific Road Builder and Engineering Review, June 1938, Vol. 48, No. 6, pp. 22-23.

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Summarized data on Federal Reclamation projects. (Indexed data of Engineering, Agricultural Settlement and Financial information of all projects), mimeographed, July 1938, 217 pages. Limited edition.

Warne, William E.

The drainage Basin Studies: Cooperative Federalism in Practice; Iowa Law Review, May 1938, vol. 23, No. 4, pp. 565-72.

Note.—This list of articles is published for convenience of reference, but the Bureau of Reclamation does not have extra copies of the articles for distribution.

Shoshone Settlement Opportunities

NOTICE to the public through the press was issued that as of July 15, applications would be received by the superintendent of the Shoshone project at Powell, Wyo., from prospective homesteaders for seven irrigable farms on the Willwood division of the Shoshone project.

The seven farms range in size from 60 to 91 acres, and contain a total of 555.65 acres. The homestead offerings are made under the reclamation law, which gives veterans a 90-day preference right of entry. The general opening, if any farm units remain, will be on October 15.

CCC Program for Federal Reclamation Projects, Fiscal Year 1939

FOLLOWING the recent decision to permit the continuation of C. C. C. camps on reclamation projects, subject to limiting the work to lands in Government ownership, the Director of the Civilian Conservation Corps has authorized the allocation of 10 additional C. C. C. camps to the Bureau of Reclamation to bring the total to 44 reclamation camps for the fiscal year 1939.

The C. C. C. boys on reclamation projects will continue a general program seeking to improve the conservation of our soil and water resources, through the construction and improvement of irrigation systems, the provision of supplemental water supplies and the development of recreational facilities at irrigation reservoirs. The 10 additional camps have permitted a more general distribution of our C. C. C. activities throughout the West: the 44 camps being assigned by projects, during the first half of the fiscal year, as follows:

Belle Fourche:
- BR-2, Fruitdale, S. Dak.

Boise:
- BR-24, Huston, Idaho.
- BR-73, Meridian, Idaho.

Carlsbad:
- BR-3, BR-82, Carlsbad, N. Mex.

Central Valley:
- BR-84, BR-85, Redding Calif.

Deschutes:
- BR-75, BR-76, BR-77, Wikiup Reservoir (Lapine, Oreg.).

Grand Valley:
- BR-22, Grand Junction, Colo.
- BR-59, Palisade, Colo.

Huntley:
- BR-57, Ballantine, Mont.

Kendrick:
- BR-79, Alcova Reservoir, Wyo.

Klamath:
- BR-11, Merrill, Oreg.

Lower Yellowstone:
- BR-30, Sidney, Mont.

Milk River:
- BR-32, Babb, Mont.[1]
- BR-69, Malta, Mont.

Minidoka:
- BR-27, Rupert, Idaho.
- BR-56, Paul, Idaho.

Moon Lake:
- BR-11, Bridgeland, Utah.

Newlands:
- BR-34, BR-35, Fallon, Nev.

North Platte:
- BR-1, Minatare, Nebr.
- BR-53, Mitchell, Nebr.
- BR-83, Veteran, Wyo.

Orland:
- BR-78, Orland, Calif.

Owyhee:
- BR-42, Ontario, Oreg.
- BR-43, Nyssa, Oreg.

Provo River:
- BR-64, Heber, Utah.

Rio Grande:
- BR-4, Ysleta, Tex.
- BR-8, Elephant Butte, N. Mex.
- BR-39, Las Cruces, N. Mex.
- BR-54, Elephant Butte, N. Mex.

Shoshone:
- BR-7, Deaver, Wyo.
- BR-72, Powell, Wyo.
- BR-87, Cody, Wyo.

Sun River:
- BR-33, Pishkun Reservoir, Mont.[1]
- BR-80, Fairfield, Mont.

Uncompahgre:
- BR-23, BR-71, Montrose, Colo.

Vale:
- BR-45, Vale, Oreg.

Yakima:
- BR-58, Sunnyside, Wash.
- BR-66, Yakima, Wash.

Yuma:
- BR-13, BR-74, Yuma, Ariz.[2]

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[1] Close about October 1, 1938.
[2] Open about October 1, 1938.

Yuma Grapefruit

PICKING of the season's grapefruit on the Yuma auxiliary project has been completed. The new growth is developing in good shape with a noticeably heavy crop on the trees. It is expected that this season's grapefruit will be larger than that of previous years owing to the increase of several young orchards now bearing more fruit than last year.

Drownings in Boise Main Canal

THE Boise Project Board of Control reports that on June 26 Ray Hunt and wife, with Frank Brandt and wife, were traveling the bank of the Main Canal, and while shooting squirrels and birds their car went into the canal, both ladies being drowned.

Mrs. Hunt's body was found in the car when it was taken from the canal. Mrs. Brandt's body had not been found when the report was made, at which time crews were dragging the canal and screens were placed in the canal 6 miles from where the car went in.

News of these drownings in the Boise Main Canal is received with regret by the Bureau of Reclamation and sympathies are hereby extended to the bereaved husbands.

Moon Lake Dam and Reservoir Moon Lake Project, Utah

By E. J. WESTERHOUSE, *Construction Engineer, Duchesne, Utah*

CONSTRUCTION of Moon Lake project was approved by the President of the United States on November 6, 1935. The sum of $1,500,000 was allotted to the project by the Public Works Administration and the Emergency Relief Administration for construction costs. The work contemplated construction of an earth-fill dam and reservoir at Moon Lake as the principal feature. The dam site lies 35 miles north from Duchesne, Utah, on the wooded south slope of the Uinta Mountain Range. Within its area Moon Lake occupies part of a cirque dammed by alluvial deposits in a chasmlike gorge. The dam was built to form above the lake outlet a reservoir of 30,000 acre-feet capacity, raising the level of the lake 56 feet. The dam and reservoir clearing, including engineering and overhead, cost $1,210,000. As additional features the project also includes construction of the Midview storage dam and diversion canals. The combined structures supplement water for 65,000 acres along the Lake Fork and Uinta rivers thereby providing the irrigation farmers occupying those lands with a reliable water supply.

Contracts and Agreements

On June 22, 1934, a contract was executed with the Moon Lake Water Users' Association providing for repayment to the Government of the construction cost of Moon Lake Dam in 40 annual installments, limited to an obligation of $1,500,000. A subsequent amendment to include the construction of Midview Dam and diversion canals did not alter the repayment terms.

The contract for the construction of Moon Lake Dam was awarded to T. E. Connolly of San Francisco, Calif., on April 3, 1935. Work was started on May 7, 1935, and the dam completed in May 1938. Contract earnings thereunder, including extra work, total $737,000. The cost of materials furnished the contractor by the Government, including all concrete aggregates, was $227,700.

Meteorologic and Geologic Features

Lying at an elevation of more than 8,000 feet above sea level the winters of the Moon Lake region are long and severe. Low temperatures and deep snows generally prevail from November to May in a degree to preclude outdoor construction work. Inclement weather actually reduced the working time for efficient performance on earthwork and concrete construction to an average of 120 days annually during the 3 years occupied with contract work.

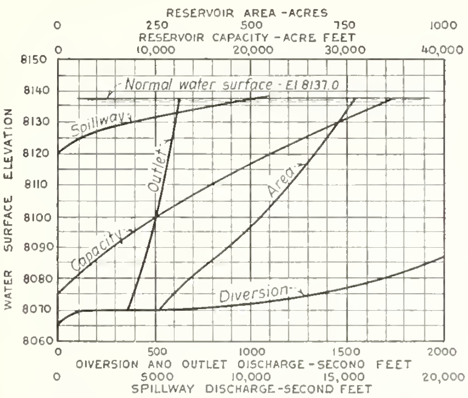
An alluvial fan of impervious deposit forms the abutment at the right of the dam. It is made up predominantly of "rock flour" in which sand grains, pebbles, cobbles, and boulders are scattered irregularly. Formations of the left abutment consist of a series of sedimentary strata. The member chiefly responsible is a spur of shales overburdened with beds of quartzite and limestones lying at elevations above the crest of the dam and sloping down to the lower portal of the outlet tunnel. The strata of these formations have been deformed through and through by the folding and faulting that took place in former times. This is the ground through which the outlet tunnel was driven.

Moon Lake Dam, completed in May 1938. The excavation along the top of the embankment is for later construction of a parapet and curb wall. Present water surface of reservoir, elevation 8,093 (lower right)

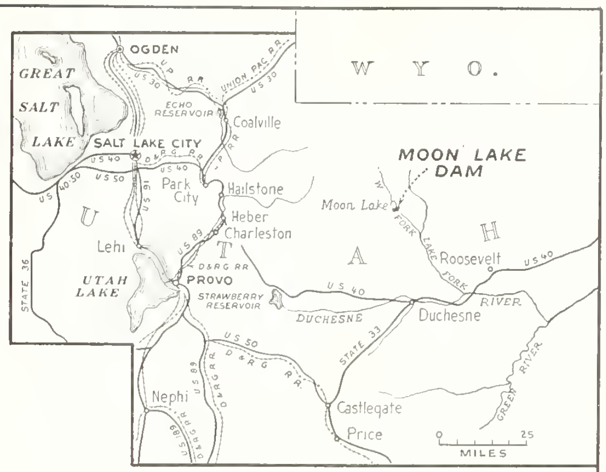
Dam Embankment

The dam is of the earth-fill type, the main body consisting of a rolled embankment protected on the downstream slope by a heavy rock fill and by a layer of riprap on the upstream slope. Located above the axis of the dam and designed to arrest percolation is a concrete cut-off wall built into the left abutment. It extends across the foundation floor where it conjoins with a cut-off trench in the right abutment. In stripping for the embankment, ground water was encountered at elevation 8049. Except for two leachy contact seams of a sizeable gouge that originate high up in the shales forming the left abutment the degree of percolation appeared negligible. The fault zone responsible for the gouge stretches from the left abutment across the foundation floor of the earth embankment and under the concrete cut-off wall. After completing the dam embankment the contact seams of crushed shale and other perceptible water bearing strata occurring in the abutments and foundation floor were sealed with fluid cement injected under high pressure. To accomplish this result 1,848 sacks of cement were required.

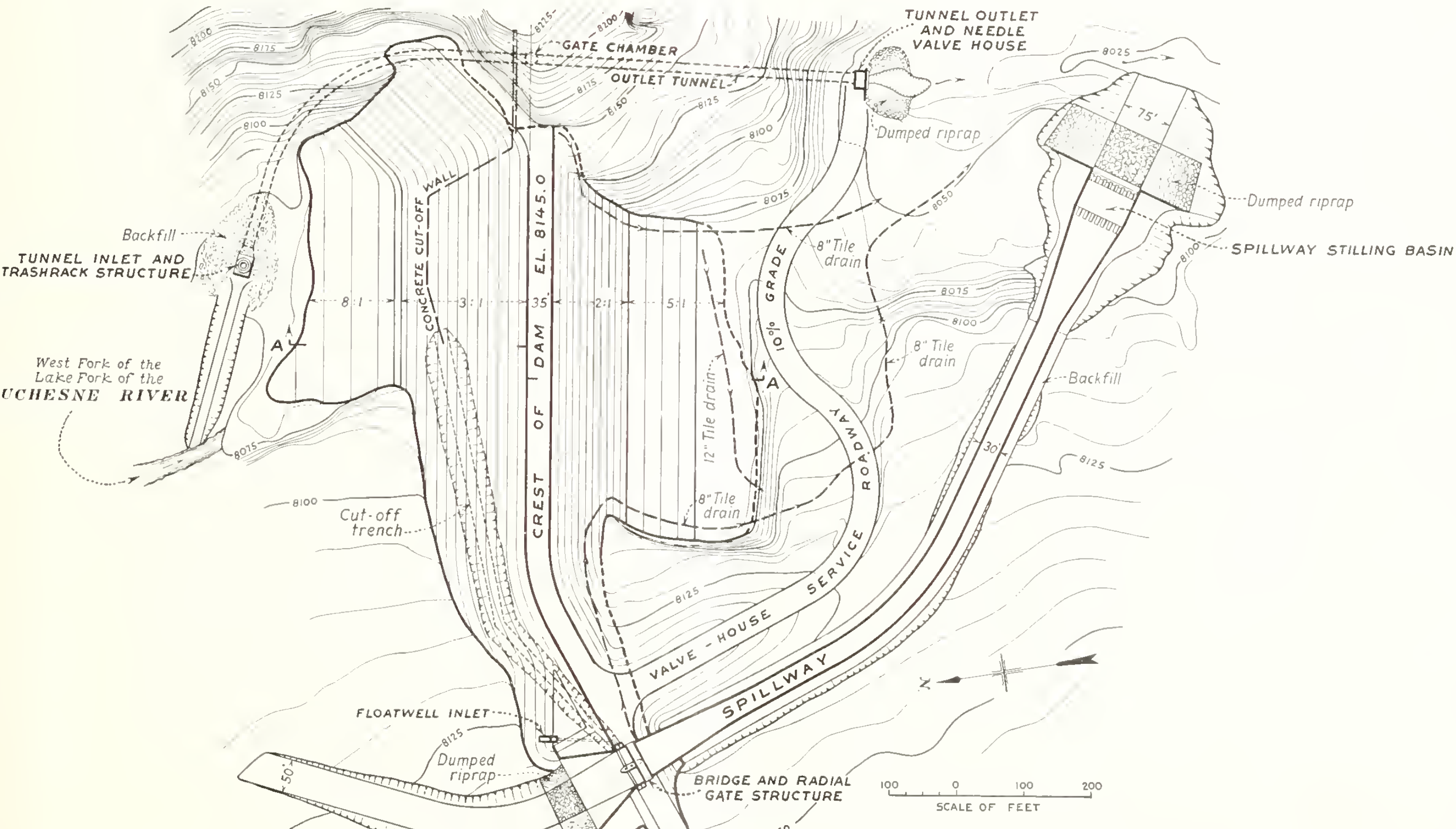
Material for the impervious earth-fill portion of the dam embankment was borrowed from pits with an average haul of 2,750 feet. Placement was made in horizontal layers of



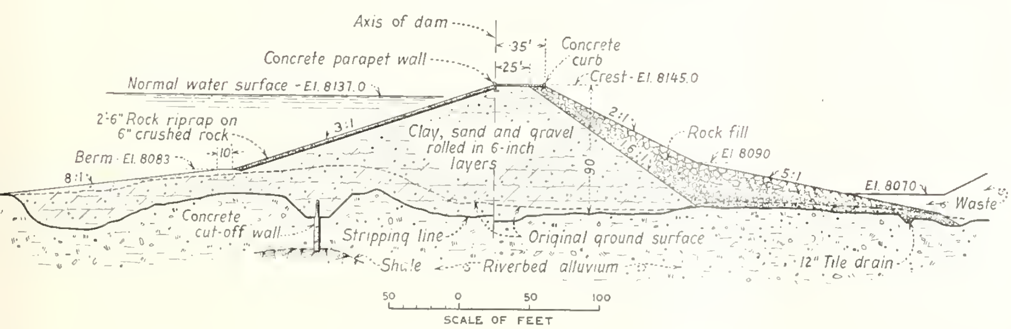
AREA-CAPACITY DISCHARGE CURVES



LOCATION MAP



GENERAL PLAN



SECTION A-A

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
MOON LAKE PROJECT, UTAH
MOON LAKE DAM
GENERAL DRAWING
209-D-376

not more than 6 inches in thickness. The required moisture content was obtained through irrigating the borrow pit area prior to excavation and adding water by sprinkling on the embankment. Twelve passages of an approved sheeps-foot roller produced satisfactory compaction. Embankment density record tests representative of compaction, moisture, and material characteristics averaged dry densities of 122.7 pounds per cubic foot as compared with an average maximum obtainable in the laboratory of 121.4 pounds at an optimum moisture content of 11.3 percent of the dry weight. The semi-impervious portions of the embankment were constructed with material from required excavation. Rock for riprapping the upstream slope and for the downstream rock fill was obtained from required excavation and from borrow pits. Quantities placed in the embankment represent 403,300 cubic yards of earth fill, 75,100 cubic yards of rock fill, and 15,100 cubic yards of riprap. The dam has a crest length of 1,120 feet and is 110 feet high above the lowest point of the foundation.

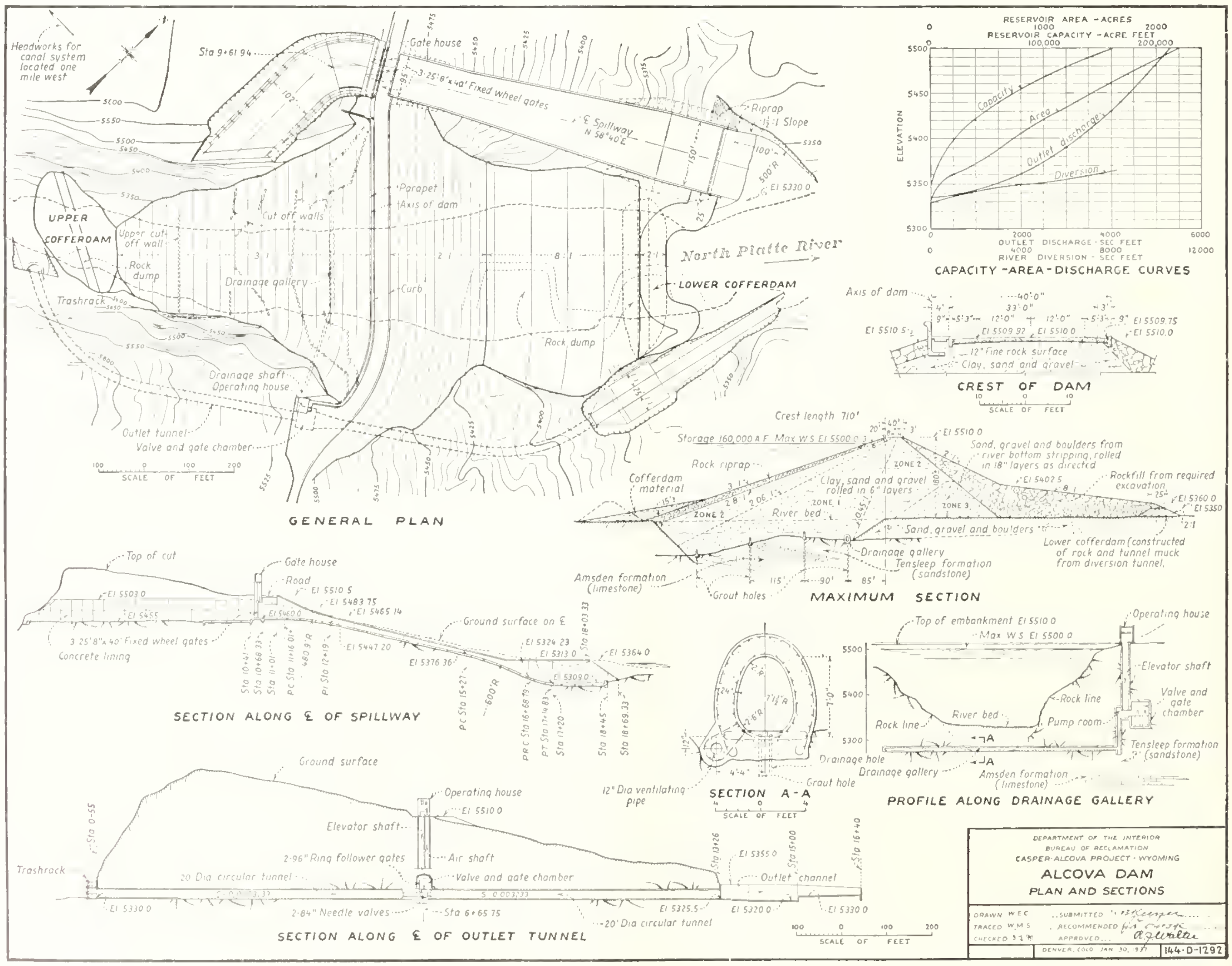
Outlet Works

The outlet works were originally designed to accommodate in the left abutment a concrete-lined side channel spillway in open excavation. However, early surveys and investigations had failed to disclose the factual background regarding the structural condition of the shales forming this abutment. Under excavation the formation proved too unstable to hazard construction of the proposed spillway, whereupon the design was changed to an open channel type located on the right abutment.

A pioneer bore driven for the full length of the outlet tunnel required heavy timbering throughout. Internally shattered and deformed shales made up 705 feet of the tunnel bore. Perpetual ice in broken limestones lying at higher elevations lubricates this ground through a myriad of seams, joints, and fault zones of crushed shale. Consequently, when final excavation and concurrent steel-liner plate installation got underway, cave-ins and unavoidable overbreaks commonly ocurred. The remaining 210 feet of tunnel excavation was made through the bed of broken limestone sloping down to the outlet portal. All tunnel work proved hazardous.

The outlet tunnel is circular in section, having an inside diameter of 10 feet, and an 18-inch thickness of concrete lining. Steel liner plates with I-beam ribs, spaced at intervals contingent upon ground stability, were installed throughout the normal circular section of the tunnel bore and gate chamber, a distance of 915.16 feet. A horizontal piston pump and pipe line, known as the Pumpcrete system, was used in the placement of concrete in the steel-lined section of tunnel and gate chamber. All other concrete was placed by hand methods. Pneumatic equipment was employed to fill by the grouting method spaces remaining unfilled in the tunnel arches and over cut-off collars after the placing of concrete had otherwise been completed. After a period of exposure it developed that the otherwise durable shale left in place surrounding the tunnel and gate chamber had air-slaked to an appreciable extent. This

(*Continued on page 171*)



ALCOVA DAM

By JOHN A. BEEMER, *Resident Engineer, Kendrick Project*

{ See plan and sections on opposite page }

ALCOVA DAM is one of the three major units in the Kendrick (formerly called Casper-Alcova) project under construction by the Bureau of Reclamation on the North Platte River in Wyoming, and the first to be completed. The other units in progress of construction are the Seminoe Dam and power plant and the Casper Canal and lateral system.

Location and Purpose

The dam is located in Alcova Canyon, 32 miles southwest of Casper, Wyo., and about 0 miles down river from Pathfinder Dam. t raises the water surface to elevation ,500, or 170 feet above river bed at the dam, o permit diversion of water into Casper Canal through a tunnel in the reservoir rim bout 1½ miles to the west.

The public is showing considerable interest n the recreational advantages made possible y the construction. The newly formed lake as a delightful and colorful setting and extends far up into the hitherto inaccessible Fremont Canyon. Boating and fishing on the ake and camping along the shores are lready attracting many visitors.

General Description of Dam and Appurtenant Structures

The dam is an earth, gravel, and rockfill ructure with an open channel spillway in he north abutment. The diversion and outlet works are constructed through the south butment in tunnel and shaft, the outlet unnel serving for temporary river diversion uring construction.

The dam embankment is 186 feet in height bove the river bed, 265 feet in height above he lowest point of the foundation, and 763 eet long. The upstream part of the dam onsists of a moistened and rolled fill of clay, and, and gravel, and the upstream slope is overed with a layer of rock riprap varying n thickness from 15 feet at the bottom of the ope to 3 feet at the top. The downstream art of the dam consists of more pervious moistened and rolled fill of sand, gravel, and oulders, with a covering of heavy rock fill xtending downstream to and including the ownstream cofferdam. Three concrete cutff walls 6 to 20 feet in height were constructed across the foundation and up the butments to the upstream slope of the earth ll. Four additional cut-off walls were constructed from the stripped canyon bottom p rock abutments, the downstream walls on ach side being extended to the end of the dam. Cut-off extensions, or curtains, were constructed below the wall footing by grouting the foundation rock through holes drilled 50 to 100 feet deep and 5 to 10 feet apart. The entire rock foundation for the earth-fill portion of the dam, including the abutments, was blanket-grouted. Drainage for the foundation was provided by a gallery under the dam with tunnel extensions into each abutment. Drainage holes, extending into the underlying limestone formation were drilled from the drainage gallery. The drainage water is discharged from the gallery through a drainage shaft into the outlet tunnel in the south abutment.

The spillway is a concrete-lined open channel 900 feet long, 95 to 150 feet wide, terminating in a stilling basin, and containing a gate structure 101.5 feet high; and an unlined approach channel 300 feet long, 102 feet wide and 50 to 120 feet deep. The flow is controlled by three automatic structural steel gates of the fixed-wheel type, each 25 feet 8 inches wide and 40 feet high. The capacity is 55,000 second-feet. The spillway is all in rock cut except for part of the stilling basin, and furnished most of the rock fill required in the dam.

The diversion and outlet works consist of a 20-foot diameter tunnel, 1,380 feet long with concrete intake and outlet structures; a concrete-lined shaft 170 feet deep, containing an elevator and an air duct, and providing access to a gate chamber constructed in an enlarged section of the tunnel; an operating house constructed at the top of the elevator shaft containing the machinery for operating elevator and gates; and the outlet control in the gate chamber consisting of two 84-inch diameter needle valves and two 96-inch diameter emergency gates.

Soon after the authorization of the project construction in 1933, a contract was let to the Lawlor-Woodward Co. of Seattle, Wash., for construction of portions of the diversion and outlet works, under Specifications No. 551. Construction of a part of the works was thus quickly started to create some immediate employment and to provide means of ready river diversion soon after designs for the dam proper could be completed. This first contract work was completed in October 1934, and consisted mainly of the diversion tunnel elevator shaft, gate chamber, and tunnel outlet structure.

Bids for the main construction, under Specifications No. 590 were opened July 15, 1935. Although the contract was not signed until October 15, the W. E. Callahan Co. and Gunther and Shirley, low bidders, began work on August 15 and proceeded at their own risk in order to complete preliminary work during low water and favorable weather.

Foundation Work

The dam is located between steep canyon walls making access difficult for foundation work. The upstream impervious section of the dam was founded on bedrock, requiring stripping to a maximum depth of 85 feet below the river bed, the greatest depth being reached in a "plunge basin," or chasm formed by a waterfall during the erosion of Alcova Canyon. The foundation rock is Tensleep sandstone, overlying Amsden limestone, dipping in a downstream direction. The upstream portion of the stripped foundation, including the plunge basin, is limestone of very irregular surface due to numerous pot holes, projections, and leached-out cavities. Many large boulders, and masses of sandstone broken from the canyon sides were encountered in the stripping excavations.

Numerous hot springs issued from the bottom and one side of the foundation to be stripped. Their total flow into the foundation, if left unchecked, would probably have been as much as 20 second-feet. Poor visibility due to vapor from these springs considerably hindered the foundation work at times, especially on cold nights. Care of these hot springs was therefore a problem of concern for the immediate foundation work as well as for the permanent construction.

The contract provided for the cost of required pumping of water from the foundations—excess of 10 second-feet to be borne by the Government. This provision as well as consideration of practicability of construction, led to the decision to attempt to complete such part of the required foundation grouting as would form a grout curtain about the excavation and cut off the hot water flows, before beginning any excavation in the river bed.

Grouting was therefore started, even before river diversion had been accomplished, in a line of holes extending from the axis of the dam upstream along the right abutment near river bend, across the river channel near the upstream toe of the dam, thence downstream along the left abutment nearly to the dam axis, to form a U-shaped curtain about the foundation excavation. This marginal portion of the blanket grouting was completed a short time after the river was diverted and before much of the foundation excavation had been done. The results were very satisfactory

as the curtain thus formed stopped most of the springs. The total flow of water from all sources into the foundation excavation never exceeded 3½ second-feet, and the most of this came through the river overburden upstream and downstream from the excavation. The rest of the foundation blanket grouting inside the U-shaped curtain closely followed the stripping work as the foundation work was uncovered, and was completed about the same time as the stripping. The total leakage through the stripped rock foundation when the regular blanket grouting was completed was somewhat less than 1 second-foot. Most of these small leaks were stopped or decreased by grouting through additional holes after the regular grouting had been completed, until it was considered that those remaining could be taken care of by gravel drains, later grouted under the embankment fill, or harmlessly smothered.

Grout holes were all 2-inch diameter, diamond drilled, and the entire rock foundation for the earth-fill portion of the dam was blanket-grouted through holes, mostly 30 to 50 feet in depth, at approximately 20-foot spacing, and extending into the limestone. Grout curtains were constructed under the three main cut-off walls to depths of 50 to 100 feet. Additional grouting was done at various depths and spacing of holes where the needs were apparent as areas of bed rock and for sealing leaks after the regular grouting work had been done. This blanket and cut-off grouting was extended up the dam abutment just ahead of the earth-fill construction. Grout pipes were placed at seams, crevices, and overhangs in the rock abutments which were later grouted after the depth of earth fill was sufficiently determined to permit fair grouting pressure.

Much of the limestone was tight, taking little or no grout, but in many places large seams, cavities, or solution channels were tapped, usually resulting in a strong flow of hot water and taking large amounts of grout. The largest "take" was 38,000 cubic feet of grout which was pumped into one hole in the limestone below the plunge basin near the upstream toe of the dam. One sand-filled limestone cavity was interrupted by drilling only a few feet below the footing for the upstream cut-off wall. This was cleaned out and concreted, requiring 125 cubic yards of concrete. The sandstone below the canyon rims, was generally not exceptionally broken or seamy and took only medium amounts of grout, but as the abutment grouting work neared the canyon rims, the difficulties in sealing the sandstone greatly increased. The canyon rim on each side has a fairly tight caprock 10 to 15 feet thick, but between this caprock and the massive sandstone below is a formation 6 to 15 feet thick of very pervious, seamed and jointed sandstone, referred to on the job as "Cracker rock." Cut-off curtains were extended through this formation to the ends of the dam and beyond to where massive rock rises above reservoir level. This cracker rock was considered effectively sealed only after a large amount of grouting, sealing of all grout leaks along the canyon rims, with the help of Lumnite cement, and drilling of test holes and regrouting, until all seams near the cut-off curtains were apparently filled.

Alcova Dam, Kendrick Project, Wyoming

In the ordinary grouting where the "takes" were relatively small neat cement was used. Where it was apparent that the holes connected with large seams or cavities, mixtures containing one part cement up to two parts of fine dune sand were used. Most holes were two-stage grouted, the upper rock layers being first consolidated by grouting through shallow holes at low pressures and the holes then being deepened and grouted at higher pressures. The depth of holes for shallow grouting and the grouting pressures used depended upon the character of the rock. Generally the shallow grouting was done at pressures between 25 and 50 pounds per square inch through holes 15 to 30 feet deep, and the deep grouting at 100 to 200 pounds pressure. The shallow holes were washed out to avoid redrilling, where practicable, but in some cases the grout was purposely allowed to set, and the holes were redrilled. Where a hole penetrated very faulty rock, or connected with a large seam in which the grout set more slowly than in the hole, washing out the hole would cause a backflow of grout.

The average rate at which grout was taken in the dam foundation decreased progressively after the beginning of the grouting work. The following data from the drilling and grouting records are significant:

First grouting work, in latter part of 1935 (mainly for the grout curtain about the river bed excavation), drilling 13,937 linear feet, grouting 134,076 cubic feet, average grout take per linear foot—9.6 cubic feet.

First half 1936 (dam foundation), drilling 39,240 linear feet, grouting 67,467 cubic feet, average grout take per linear foot—1.8 cubic foot. Latter half 1936 (dam foundation and lower portions of abutments) drilling 15,463 linear feet, grouting 10,619 cubic feet, average grout take per linear foot—0.7 cubic foot.

Embankment Construction

Suitable materials excavated during the work of stripping for embankment were placed in the gravel and rock fills. Placing of the gravel fill during cold weather was made possible by the heat in the materials due to the hot springs in and about the foundation being stripped. The gravel fill was placed in layers about 18 inches thick and was compacted by sluicing and rolling and by hand work tamping along the abutment.

After the foundation stripping was completed nearly all the remaining rock for the

lownstream rock fill and the riprapping was aken from spillway excavation, selected rock peing used for riprap. The rock fill was built ip in approximately 3-foot layers and each ayer was sluiced with a stream of water to produce as much settlement and consolidation is practicable during construction.

The earth-fill materials were obtained from porrow pits about 4,000 feet north of the lam. The materials in the pits were natu-ally more or less stratified and proportioning of the soil, sand and gravel was regulated by the depths of the shovel cuts. The mate-ials were moistened by irrigation of the porrow pits ahead of the excavation, and when necessary additional moistening was ecured by sprinkling at the pit during exca-ation. The materials were dumped on the ll, dozed into layers, and rolled 12 times vith tamping rollers weighing about 1,700 pounds per linear foot of tread. The layers vere approximately 6 inches thick after ompaction. Pneumatic and Barco power ampers were used for compacting the em-ankment on the rough foundation and along he abutments and cut-off walls. Continuous lose inspection was maintained both on the mbankment and at the borrow pits.

Portions of the foundations, where neces-ary, were especially prepared to protect he earth fill from becoming too wet for roper compaction. The upstream and down-tream water bearing river bed excavation opes were prepared ahead of the fill work y constructing rock drains covered with ravel leading to a pump sump on the up-tream slope and to a drain alongside the rainage gallery at the bottom of the down-tream slope. Seeps in the rock bottom of he canyon and along the base of the right butment which special grouting work failed o stop were controlled during the placing of he fill by means of gravel pockets and rains. Grout pipes were connected to these ockets and drains, and each was later routed under a depth of fill.

Laboratory and field tests for control of noisture, density, permeability, and propor-oning of the materials were carried on ontinuously in accordance with the stand-rd methods of the Bureau.

Appurtenant Structures

Completion of the outlet works not con-tructed under the previous contract involved nainly the following construction in the rder named: Construction of the concrete nd steel trashrack structure at the tunnel itake, riprapping channel below the tunnel itlet structure, construction of the outlet orks operating house, installing the freight evator, concreting and grouting the tunnel ug just upstream from the gate chamber, nd installation of the two 96-inch ring-fol-wer emergency gates and the two 84-inch ternal differential needle valves, with op-rating machinery. This construction was ecessarily timed to meet requirements for diversion of irrigation water up to a maximum flow of 6,500 second-feet, the final tunnel plug and gate and valve installations being completed during the late fall and winter of 1937–38.

The concrete cut-off walls were constructed in the canyon bottom in sections at convenient times before and during the placing of the earth embankment and the construction was continued up the abutments just ahead of the embankment work. Trenches for the wall footings 2 feet or more in depth were excavated in the bedrock by line drilling and light blasting. The constructed walls extend into the earth embankment 15 to 20 feet at the canyon bottom and decrease in height to 5 or 6 feet at their highest locations.

The drainage gallery under the downstream portion of the earth embankment was constructed in open cut across the stripped foundation and extended into the abutments by tunneling and has a total length of 500 feet. The inside section is oval-shaped, 7 feet high, and 5 feet wide. The concrete lining is 2 feet in thickness. Considerable difficulty was experienced in the construction due to encountering hot water under pressure. This was handled mainly by pumping from temporary drains. After completion of the gallery 25 drainage holes were drilled below pipes set in the gallery invert to depths of 60 to 70 feet at 20-foot spacing. The holes extended through the sandstone and 10 to 15 feet into the underlying limestone. The drain holes in completion produced a flow of hot water estimated at 85 gallons per minute. Excavating and lining of the drainage shaft connecting the south end of the drainage gallery with the outlet tunnel completed the foundation drainage system for the dam.

Spillway excavation was carried on at such times as to furnish the required rock for construction as the embankment fill was built up. All of the concrete work, approximately 18,000 cubic yards, was completed between April and November 1937. The concrete was placed by the pumpcrete method. Concreting proceeded from the stilling basin upstream, closely following the completing and trimming of the excavation. Completion of this concrete work so that the spillway could be brought into action if required, was considered necessary before the installations were begun in the diversion tunnel. Installation of the spillway gates and operating mechanisms, involving about 400 tons of metal work, was completed after the reservoir filling had started.

On February 8, 1938, storage water was released from Pathfinder Reservoir and the Alcova Reservoir was slowly filled to elevation 5,454 by April 23, 1938, placing a head of 124 feet against the Alcova Dam. The dam and foundations are apparently tight up to this elevation, and the results of weekly observations on the hydrostatic pressure cells installed in the dam embankment are considered very satisfactory.

Principal Construction Quantities

Excavation, common, stripping for embankment______cubic yards__	187,538
Excavation, rock, stripping for embankment_________cubic yards__	26,952
Structure backfill________do____	21,855
Dam embankment, earth and gravel____________cubic yards__	1,021,089
Dam embankment, rock____do____	423,988
Rock riprap and masonry__do____	62,855
Grout holes (1,324 holes)______linear feet__	81,670
Pressure grouting____cubic feet__	245,675
Drainage and seep holes____do____	4,989
Clay-pipe drains_____linear feet__	6,108
Concrete____________cubic yards__	23,063.5
Reinforcement steel______pounds__	2,317,434
Metalwork installations ____do____	2,063,031

While the final cost figures relating to the completed dam are not yet available, the costs of all principal features will approximate very closely the following:

Diversion and care of river______	$31,500
Foundation____________________	773,700
Drainage gallery and tunnels___	74,900
Diversion tunnel and outlet works_	749,500
Spillway ______________________	952,400
Embankment __________________	547,700
Clearing reservoir______________	56,200
Land and rights-of-way__________	29,200
	3,214,100

National Reclamation Association Meets

THE annual meeting of the National Reclamation Association has been announced for October 11–13, inclusive, and will be held at Reno, Nev.

Boulder Dam Power

SECRETARY of the Interior Ickes approved a contract with the city of Los Angeles under which the city agrees to construct a third circuit to Boulder Dam and to buy certain stipulated amounts of secondary energy at one-half mill per kilowatt-hour.

The contract also sets up a formula which will govern future adjustments of rates for Boulder Dam secondary power. All the contracts for the sale of power generated at Boulder Dam call for readjustment in 1945 and at 10-year intervals thereafter.

The city now has in operation two high tension circuits each 250 miles long, extending from Boulder Dam to the city. Under the new contract the city agrees to construct at its own cost and to operate and maintain a third transmission circuit, with the necessary switching station, receiving-station facilities, and other equipment necessary to increase the effective aggregate operating capacity of its transmission facilities by 150,000 kilowatts.

Exploration in the Grand Canyon

By C. H. BIRDSEYE, *Chief, Division of Engraving and Printing, Department of Interior, Geological Survey*[1]

GEOGRAPHICAL explorations in the United States have had no more interesting field than the Grand Canyon of the Colorado. The solo boat trip by Buzz Holmstrum in October and November 1937 and the two boat trips which are planned for the summer of 1938[2] make it appropriate to review briefly the part that the Geological Survey has played in these explorations.

The list of previous expeditions cited in the account of Holmstrum's trip in the RECLAMATION ERA for March 1938 omitted several. It will be seen from the following list that 15 parties rather than 5 have traversed at least the Grand Canyon part of the river.

Major Powell makes first trip

The first trip was made in 1869 by Maj. J. W. Powell, the second Director of the Geological Survey, who traversed the Green and Colorado Rivers from Green River, Utah to the mouth of the Virgin River. Major Powell made a second trip in 1871, ending at Kanab Creek. In the same year the Wheeler expedition battled the rapids up the lower part of the canyon as far as the mouth of Diamond Creek. In 1889, the Brown-Stanton expeditions journeyed from Green River, Utah, to the Gulf of California. The leader, Frank M. Brown, and two of his men were drowned in Soap Creek Rapid. In 1896 Nathan Galloway and one companion traversed the rivers from Green River, Wyo., to Needles, Calif. In the same year, George Flavell and one companion traversed the rivers from Green River, Wyo., to Yuma, Ariz. Next came the Russell-Monett expedition in 1907, on which Charles Russell, E. R. Monett, and Bert Loper boated from Green River, Utah, to Needles, Calif. In 1909 Julius Stone, accompanied by Nathan Galloway and four others, made the complete trip from Green River, Wyo., to Needles, Calif. In 1911 Emery and Ellsworth Kolb, of Grand Canyon, journeyed all the way from Green River, Wyo. to the Gulf of California. In 1921 the Geological Survey traversed and surveyed Colorado River from the mouth of Green River to Lees Ferry, Ariz. In 1922 the Geological Survey continued the same type of surveys of Green River from Green River, Utah, to its mouth. In 1923 the Survey traversed and surveyed the river from Lees Ferry to Needles, Calif., and a brief description of this trip is given below. In 1927 Clyde Eddy, of Port Washington, N. Y., with nine college students and three other men in three boats, navigated the river from Green River, Utah, to Needles, Calif. In December of the same year Eddy joined a Hollywood motion-picture party at Lees Ferry and traversed the Colorado as far as Bright Angel Creek. E. C. LaRue was chief of this party with Frank Dodge as head boatman. In 1928 a newly married couple, Glen R. Hyde and wife, of Hausen, Idaho, tried to boat the river through the Grand Canyon but were drowned below Diamond Creek, and their boat was found by Emery Kolb at Separation Rapids. In 1933 R. G. Frazier and five other men made the trip from Green River, Wyo., to Boulder Dam. In 1935 engineers of the Soil Conservation Service and Fairchild Aerial Surveys made two trips from the mouth of Diamond Creek to Pierces Ferry, just above Grand Wash Canyon, making surveys to determine the silt content of what is now Lake Mead.

Holmstrum's trip in 1937 stands out as one of the most remarkable trips since Powell's first voyage, principally because he made the entire trip alone from Green River, Utah, to Boulder Dam, and in the record time of 52 days.

By 1921 the Geological Survey had made detailed plan and profile maps of the entire Colorado River and its tributaries, except the stretch through the Grand Canyon. A year later a group of engineers and others interested in the development of the Colorado River[3] boated through the placid waters of Glen Canyon to Lees Ferry and came upon the three boats of the cataract type used on the Cataract Canyon survey in 1921. Then and there it was decided to finish the job in 1923, and to make detailed surveys of the river through the Grand Canyon area. The writer spent much of the winter and spring in organizing the party, planning suitable equipment, and selecting skilled men for both scientific work and river navigation.[4]

Geological Survey Trip

The party left Lees Ferry on August 1. Our Grand Canyon fleet consisted of four boats of the Galloway type, named after four Colorado River canyons—Grand, Glen, Marble, and Mohave—and a collapsible canvas boat designed for easy portage and to assist the boatmen in case of trouble below the rapids. But the canvas boat withstood only the first 12 rapids and was lost in trying to line it through the thirteenth rapid.

As with all boats of the Galloway type, the oarsman sat in the open cockpit in the center, running the rapids stern first so as to have as much chance as possible to avoid the rocks and rough waves. All the men wore life jackets, and in rough water the passengers lay face down on the decks clinging to the life lines strung along the gunwales. Light sleeping bags, air mattresses, and other equipment, including personal dunnage, which was kept to the absolute minimum, were packed in watertight bags. Instruments, including a radio, map sheets, and an assortment of still and motion-picture cameras, with a plentiful supply of film, were carried in watertight boxes. The radio reception in the canyon was exceedingly good, in spite of predictions that reception in a deep canyon was impossible. At the second camp, at Soap Creek Rapids the party heard by radio of the death of President Harding, three-quarters of an hour after it occurred, probably before most of the people of the United States had learned of it.

Four miles below Lees Ferry, at the entrance to Marble Canyon, the canyon walls commenced to rise slowly, until at Bright Angel the canyon runs were a mile or more above the river. The members of the party, however, did not have time to pay much attention to the scenery except to record it in pictures, many of which are excellent. A popular description of the trip, by Lewis R. Freeman, entitled "Surveying the Grand Canyon of the Colorado," appeared in the National Geographic Magazine for May 1924.

Burchard ran an unbroken plane-table traverse and level line from Lees Ferry to Last Chance Rapids, a distance of 252 miles, where he joined his 1920 survey with a gross error in elevation of only 9 feet. LaRue specified the limits of the surveys to be made, measured the stream flow in all side streams, and was official photographer of the expedition. Moore examined rock structure and made general geologic studies throughout the canyon area. Burchard carried his mapping up the canyon walls high enough to provide data for measur-

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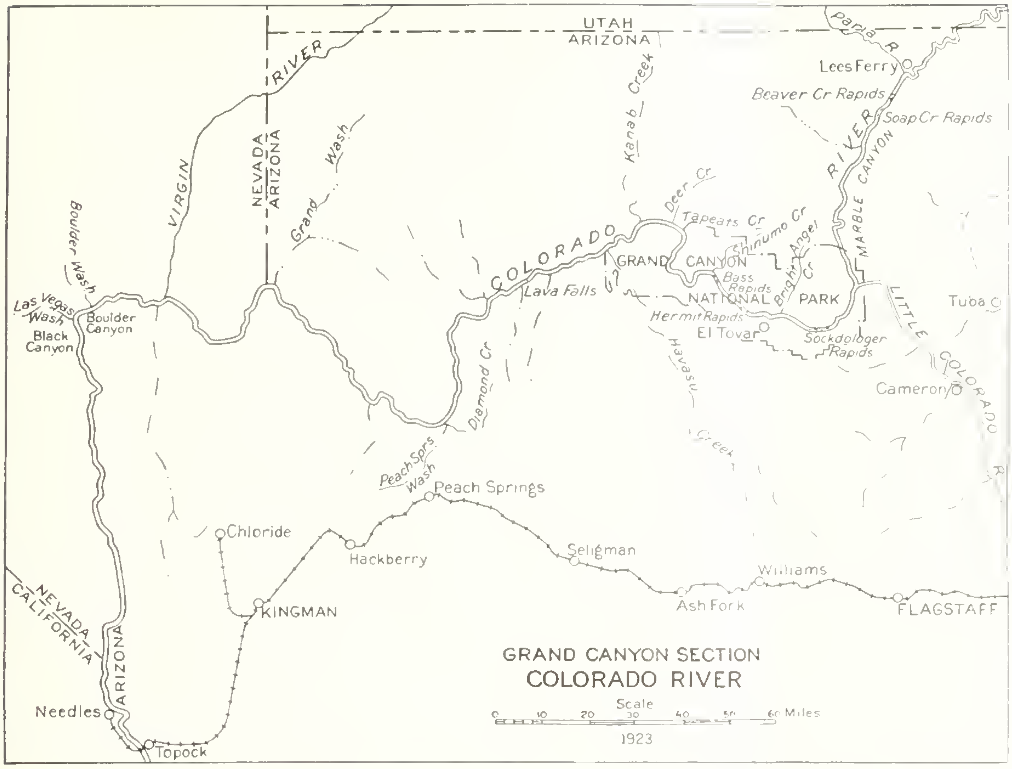
[1] Published by permission of the Director, Geological Survey.

[2] Norman D. Nevills, with a party of geologists and botanists, including two girls, planned to leave Green River, Utah, late in June and navigate the river as far as Boulder Dam; Amos Burg, with one companion, plans to navigate the Green and Colorado Rivers from Green River Lakes, Wyo., to the Gulf of California, starting early in October.

[3] The party included Arthur P. Davis, Director of Reclamation; Harry W. Dennis, chief civil engineer of the Southern California Edison Co.; Herman Stabler, E. C. LaRue, and the writer, of the Geological Survey; Dr. Widtsoe, one of the Mormon apostles; R. E. Caldwell, State engineer of Utah; R. D. Young, president of Richfield Stake, Utah; and C. C. Stetson, representative of the Colorado River Commission.

[4] The party consisted of 10 men, the scientific members being E. C. La Rue, hydraulic engineer; R. C. Moore, Geologist; R. W. Burchard, topographic engineer; and C. H. Birdseye, director of the party. The navigators included E. C. Kolb, head boatman; Lewis R. Freeman, Leigh Lint, H. E. Blake, and Frank Dodge, boatmen; and Frank Word, cook. At Bright Angel, Herman Stabler joined the party as the second hydraulic engineer, and at Supai Creek, Felix Koms replaced Frank Word as cook.



Courtesy American Geographic Society

Moon Lake Dam and Reservoir

(Continued from page 166)

condition precluded high-pressure grouting without first solidifying the backfilled spalls and slaked shale behind the steel lining. Low-pressure grouting operations were accordingly extended to include filling the concomitant voids. The concrete or grout thus placed consumed 4,618 sacks of cement and 7,886 sacks of sand. Subsequent high-pressure grouting required the use of an additional 5,311 sacks of cement.

Installation in the gate chamber consists of operating mechanism and two 3 feet 3 inches by 3 feet 3 inches high-pressure slide gates. The outlet discharge is confined in two 42-inch diameter steel pipe lines installed in the tunnel. The pipes extend from the gate connections to the needle valves controlling the discharge at the lower portal of the tunnel, a distance of 474.25 feet. Within the needle valve house are installed the control mechanism and the two 36-inch needle valves having a discharge capacity of 500 second-feet.

Spillway

The permanent spillway, with a rated capacity of 10,000 second-feet, is located in the right abutment. The channel is concrete-lined having a total length of 1,269.17 feet, exclusive of riprapped sections but including the stilling basin and spillway headgate structures. Two 24- by 16-foot automatic radial gates installed in the headgate structure regulate the discharge of water over the spillway crest at elevation 8,121, sixteen feet below the high water surface level of the reservoir.

ing the capacity of reservoirs above any possible dam site, and Moore and the writer assisted in making dam-site surveys and extending the work up side canyons. In all, 19 dam-site surveys were made, and the data describing these, together with hydraulic and geologic reports on them, are published in the Survey's Water-Supply Paper 556.

The party ran 84 major rapids and portaged only 3—Soap Creek, Lava Falls, and Mattowitteki. Kolb's boat upset in a rapid just below Kanab Creek, and Freeman's boat, with Moore and LaRue as passengers, upset in Separation Rapids, the place where three members of the first Powell expedition had left the canyon and were killed by Indians. The measured fall in the highest rapid—Hance Rapid, 15 miles below the mouth of Little Colorado River—was 28 feet in a few hundred yards, but all of the boats ran it safely, and Emery Kolb's daughter Edith (now Mrs. Carl Lehnert), who had come down Hance Trail with the pack train and supplies, climbed aboard Lint's boat and shot through the rapid.

The only real trouble that the party experienced was at Lava Falls. The radio set was sent out for repairs at the mouth of Havasupai Creek and the party did not receive the flood warning that was broadcast until 3 days later. The party made an easy portage at Lava Falls. Then at sundown the river began to rise and during the night rose 21 feet, the volume of water increasing from 10,000 to more than 100,000 second-feet. Freeman's boat was elevated about 25 feet by block and tackle, and Kolb, Lint, and Blake took their boats about half a mile downstream after dark, landing on a shelving beach well above the high-water mark. The party spent 4 days at this point, and not until it reached Diamond Creek did it realize that someone at Kingman had seen a Geological Survey boat floating upside down below what is now Boulder Dam and had broadcast the report that the party was drowned. In reality, most of the members of the party had had a good rest and had spent most of the 4 days playing "penny ante" with beans for chips.

After finishing its survey work at Last Chance Rapids, which is now, of course, covered by Lake Mead, the party rigged up sails from canvas bed covers and sailed the 200 miles to Needles in 2 days. The entire trip of 450 miles was made in 80 days.

Boise Settlement Opportunities

THE distribution works for the Black Canyon division of the Boise project, Idaho, affecting 55,000 acres of land, will soon be completed. Much of the land is in private ownership, but that which is public land will be thrown open to homestead entry under regular Reclamation procedure next spring.

The process of cutting up sagebrush land into farms will begin next year, and notice to the public will be given through the press when applications will be received by prospective homesteaders.

Excavations Uncover Fossils

FOSSIL remains of a mammoth and a camel were unearthed in the construction of tunnels for the Roza division of the Yakima project.

Black Hills Round-up

THE Black Hills round-up which was held at Belle Fourche, S. Dak., early in July attracted many tourists to that section, largely because of the hard surface road now extending across South Dakota from Sioux Falls to the Black Hills.

General Superintendent Named on Shasta Dam

PACIFIC Constructors, Inc., the contractor on the Shasta Dam, Central Valley project, announces the appointment of Frank T. Crowe as general superintendent in charge.

Mr. Crowe will be remembered as the construction engineer for Six Companies Inc., the contractor on Boulder Dam, following which assignment he was placed in charge of the construction of Parker Dam. It was expected that Mr. Crowe would assume active work on Shasta Dam in August.

Final Inspection of Salt River Spillways

By F. M. SHAW, *Office Engineer, Salt River Project*

EARLY on Thursday morning, May 12, 1938, the officials, governors, councilmen, and guests of the Salt River Valley Water Users' Association were converging on the Water Users' Building in Phoenix, Ariz., to join a motor caravan to Horse Mesa and Mormon Flat dams. This occasion was the final inspection of construction work on four spillways on the Salt River, recently completed by the Bureau of Reclamation. Most of the group who made the inspection trip are shown in photograph no. 3.

The association operates and maintains the Salt River project which was constructed and operated by the Reclamation Service prior to 1917. It comprises 242,000 acres of irrigated farm land, exclusive of townsite areas, and has a total rural and urban population of 150,000. The project straddles the dry river bed of the Salt River, which is scarcely 10 feet below the adjacent terrain. Irrigation water for the project is furnished from a chain of four reservoirs on the Salt River having a total storage capacity of 1,900,000 acre-feet—enough to cover the entire project with 8 feet of water. Eighty percent of this impounded water is 80 miles from Phoenix and about 1,000 feet higher.

The high mountains and desert country which comprise a large percentage of the Salt River watershed are conducive to flash floods caused by cloudbursts and high runoff. Consequently, the association requested the United States Bureau of Reclamation to investigate, improve, and rebuild the spillways of the chain of dams, to insure prompt and safe spilling of floods of 150,000 cubic feet per second.

The work of the Bureau on the Salt River storage and power dams was completed on May 7, and, although numerous inspection trips had been made from time to time as the work progressed, the association desired to take one final look and, to a certain extent, celebrate the finish of this construction. So the members assembled and by 8 o'clock the caravan of 15 automobiles wended its way easterly through Tempe and Mesa on State Highway No. 80. Luxuriant groves of dates, olives, and citrus were seen on either side before the highline canal was crossed, about 20 miles from the starting point, where the caravan rolled out on the glaring, sun-scorched desert. At Apache Junction the caravan wheeled left, away from the paved highway, and proceeded by way of the famous Apache Trail. Superstition Mountains were to the right and the Mazatzal Range ahead and to the left. Mormon Flat Dam, 47 miles from Phoenix, was the first stop.

No one questioned the passing of Stewart Mountain Dam where a new concrete-lined spillway discharge channel 450 feet long, 265 feet wide, with side walls averaging 18 feet high, had been constructed by the Bureau. This had been seen before and had been completed for over a year.

Mormon Flat Dam

At Morman Flat Dam the party, consisting of 46 officials and guests, left their cars on the edge of the canyon and proceeded on foot to the dam. Some members had not visited the dam since before the Bureau started work. Then there was a battery of nine radial gates on an ogee spillway. This was now replaced with a concrete-lined tapered spillway 450 feet long with sidewalls 50 feet high. At the upstream end towered the gate structure, 132 feet above the spillway crest, containing two 50- by 50-foot steel regulating gates. Everyone climbed over and around the new thrust block at the left abutment of the dam, into the generator room containing two 25-kilowatt generators that supply power to the gate hoist motors, over the gate structure and up spiral stairways to the machinery room housing the huge gate hoists. Finally, all moved up inside the spillway channel for a close inspection of the regulating gates, unmindful of the fact that the gates were then holding back 45 feet of water. General satisfaction with the work accomplished was freely expressed on every hand.

Horse Mesa Dam

When everything had been seen, Lin B. Orme, president of the association, announced that the party would go to Horse Mesa Dam where a luncheon was prepared. The 18 miles to Horse Mesa Dam were filled with scenes of rugged grandeur, lofty peaks and abysmal canyons. Everyone piled out at the old mess hall at Horse Mesa and for the next half hour dallied with sandwiches, coffee, cake, fruit, and pie.

It was decided that there was too much to see at Horse Mesa Dam to consider prolonging the trip to take in the balance of the work completed by the Bureau earlier in the year. About 500 feet of diversion dam of ogee spillway section had been built in the river approximately 35 miles farther upstream, to replace the portion of the existing concrete and earth dam that was washed out by flood in 1916. Water diverted by this dam is transported 20 miles by canal to the turbines at Roosevelt Dam. The Bureau had also rehabilitated the old power canal by constructing two siphons, miscellaneous lining, and replacement of cross-drainage structures. Considerable work was done, also, on the spillways at Roosevelt Dam, whereby the radial gates were overhauled and the spillway crest lowered 5 feet.

The work done upstream was not spectacular and the attention or time of the association members could not be diverted from the inspection at Horse Mesa Dam. This dam had been constructed by the association in the years 1924 to 1927. It had been built without facility to pass water for irrigation requirements at any level below the radial gate spillway crest except through the turbines. In addition to reconstructing aprons downstream of the existing radial gate spillways to avoid eroding the abutment rock, the Bureau constructed a tunnel through the rock of the right abutment, having a nominal diameter of 30 feet.

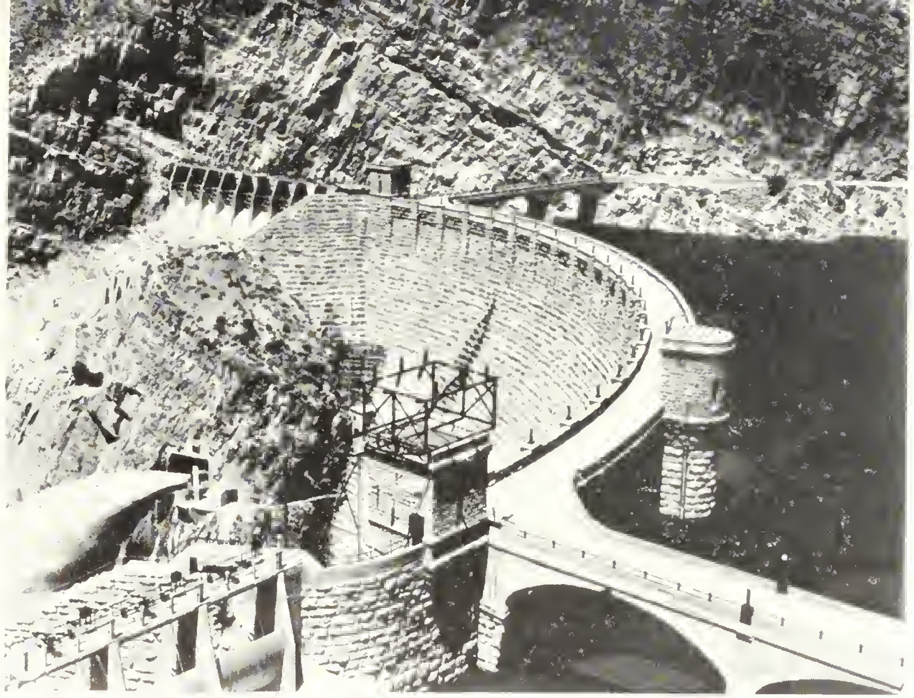
Directed by the association's superintendent and general manager, Harry A. Lawson, the 40- by 44.5-foot steel regulating gate was lifted to permit a flow of about 250 second-feet of water through the tunnel. The members of the inspecting party assembled on the opposite side of the river and watched the discharge. With the usual conservatism of water users' associations, very little water was permitted to escape in this unproductive fashion.

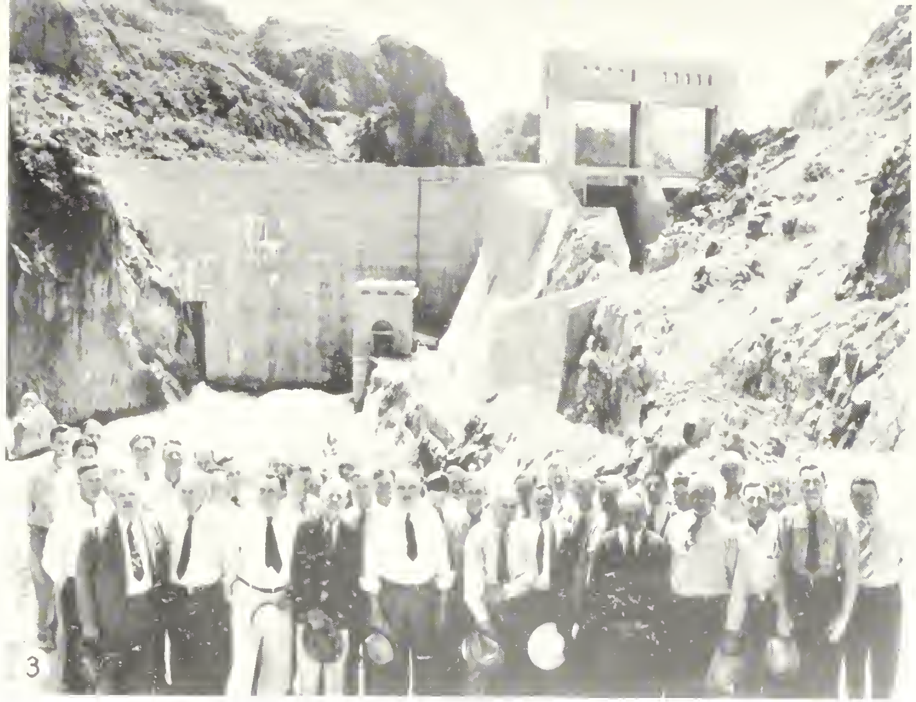
Later the party climbed to the top of the dam and inspected the new discharge channels for the radial gate spillways. There are three gates at the left abutment and six gates at the right. The new discharge channels are bucketed sections built on the edge of the precipitous cliffs, designed to throw the escaping water clear of the abutments and into the river channel, 250 feet below.

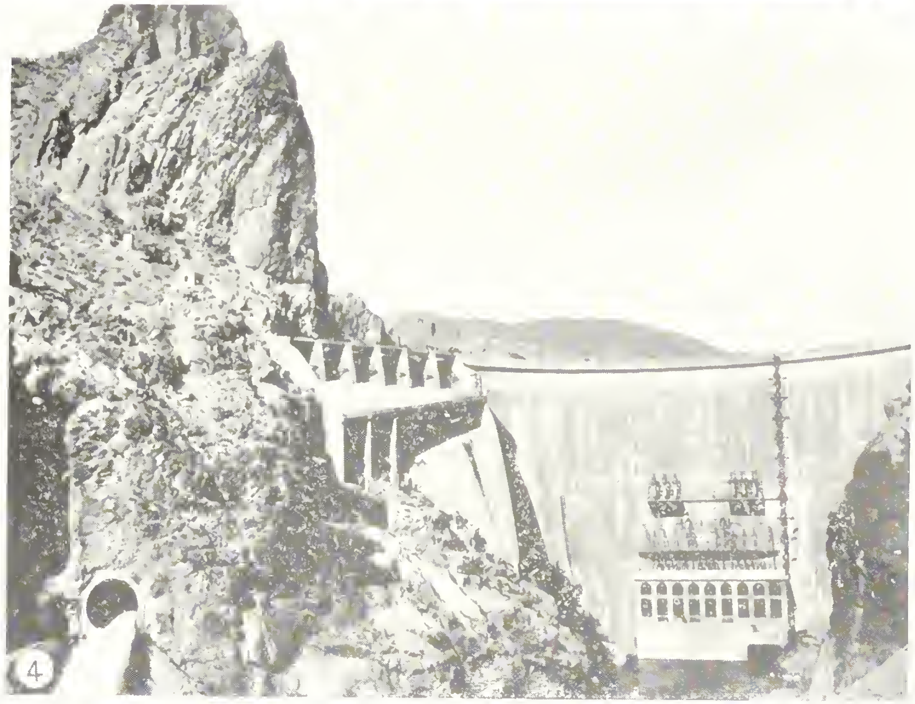
Eventually the party reached the gatehouse structure from which the flow through the tunnel is controlled. The fact that the structure towered 100 feet above the top of the dam and was surmounted by overhanging cliffs 400 feet high did not deter them from climbing concrete stairs along the face of the intervening rock to the machinery floor for a look at the gate hoist mechanism.

E. C. Koppen, Construction Engineer for the Bureau, explained, in answer to many questions, that the gate structure contained a 40 by 44.5-foot steel regulating gate and the machinery to operate it; that the crest of the tunnel spillway was 45.5 feet below the top of the dam; that power to operate the tunnel gate and the radial gates was furnished from independent gasoline-engine-generator sets located in a small concrete house on the right abutment of the dam. He told of some of the

(*Continued on page 175*)

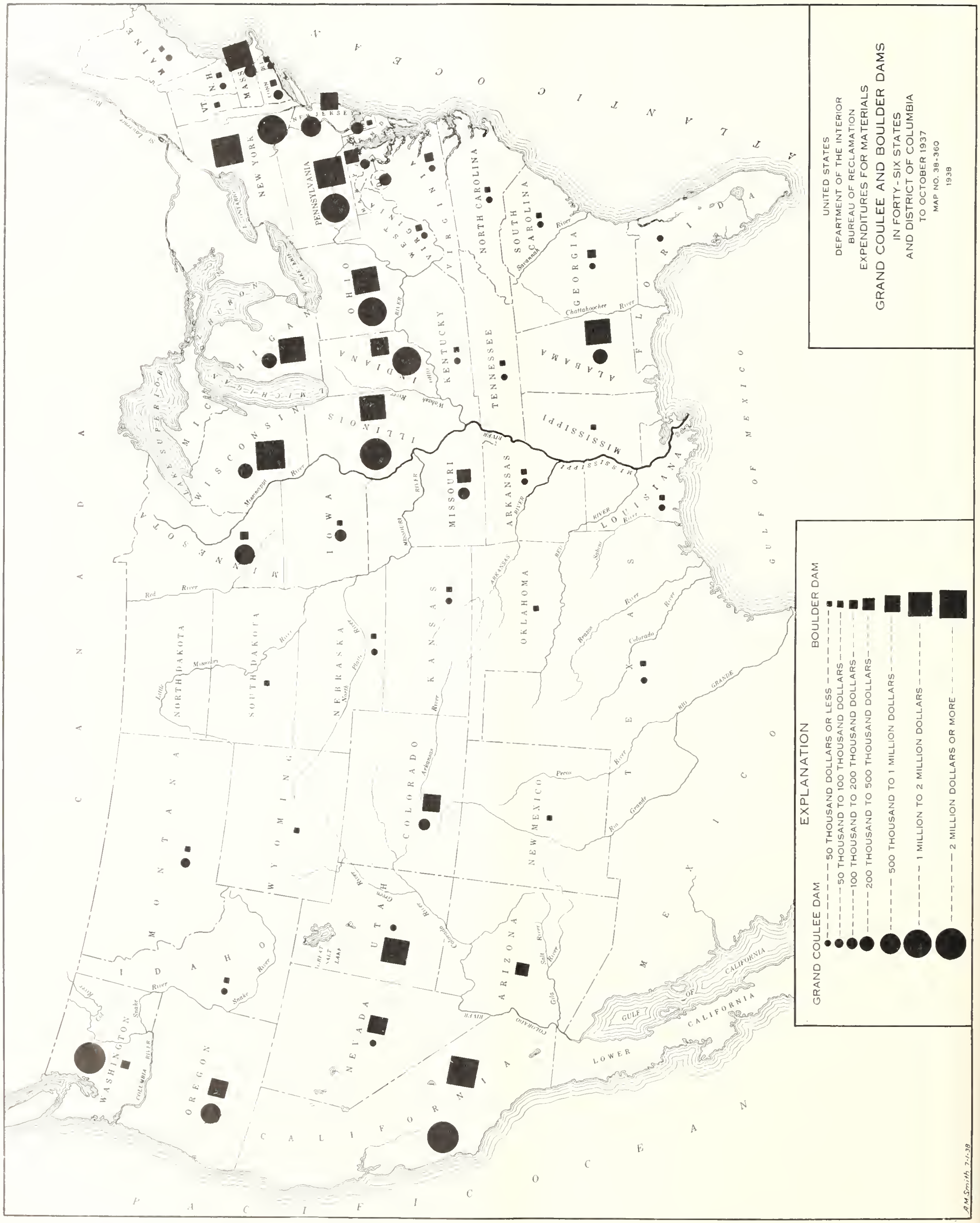






SALT RIVER SPILLWAYS

1. Roosevelt Dam—Radial gate spillways remodeled
2. Stewart Mountain Dam—New spillway discharge channel
3. Mormon Flat Dam—New tapered spillway
4. Horse Mesa Dam—New spillway tunnel. Radial gate spillways remodeled


UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
EXPENDITURES FOR MATERIALS
GRAND COULEE AND BOULDER DAMS
IN FORTY-SIX STATES
AND DISTRICT OF COLUMBIA
TO OCTOBER 1937
MAP NO. 38-360
1938
EXPLANATION
GRAND COULEE DAM
BOULDER DAM
50 THOUSAND DOLLARS OR LESS
50 THOUSAND TO 100 THOUSAND DOLLARS
100 THOUSAND TO 200 THOUSAND DOLLARS
200 THOUSAND TO 500 THOUSAND DOLLARS
500 THOUSAND TO 1 MILLION DOLLARS
1 MILLION TO 2 MILLION DOLLARS
2 MILLION DOLLARS OR MORE
ATLANTIC OCEAN
PACIFIC OCEAN
GULF OF MEXICO
GULF OF CALIFORNIA
LOWER CALIFORNIA
CANADA
MEXICO
A.M.Smith 7-1-38

Reclamation Organization Activities

Commissioner Page on Official Trips

JOHN C. PAGE, Commissioner of Reclamation, left Washington July 16 to attend the dedication exercises of 14 dams of the Muskingum Watershed and Conservancy District. The ceremony was held at Bolivar Dam, 14 miles north of New Philadelphia, Ohio. Representing Hon. Harold L. Ickes, Secretary of the Interior and Administrator of Public Works, Mr. Page addressed the group.

Also appearing on the program were General Schley and Senator Bulkley.

During his visit Mr. Page, accompanied by V. E. Warne, of the Washington Office, was shown over the other dams of the project, returning to Washington July 19.

Commissioner Page again left Washington the last week in July to attend a meeting of the Governors of the Upper Colorado Basin States. This group gathered in Yellowstone Park August 1. From Yellowstone the Commissioner made inspectional visits to the Columbia Basin project, Washington; the Central Valley project, California; and the Boise project, Idaho. The tour was planned to consume approximately three weeks.

Acting Commissioner

IN THE ABSENCE of the Commissioner and Assistant Commissioner, July 16, J. Kennard Cheadle, Chief Counsel and Assistant to the Commissioner, was deputized Acting Commissioner.

During the absence of Commissioner Page commencing July 29, Roy B. Williams, Assistant Commissioner, served as Acting Commissioner.

Assistant Commissioner Returns

ROY B. WILLIAMS, Assistant Commissioner of Reclamation, completed a 7-weeks' tour of Federal Reclamation projects and returned to the office July 18.

E. O. Larson in Washington

MR. E. O. LARSON, Construction Engineer in charge of the Provo River project, came to Washington the middle of July to assist in working out the contract details standing in the way of Deer Creek construction. From Washington Mr. Larson went to Denver to take up matters with the Bureau staff there on the Salt Lake Aqueduct, thereafter returning to his headquarters at Provo.

Personnel Changes

THE following recent personnel changes in the Bureau of Reclamation have been authorized by the Secretary of the Interior:

Appointments

Denver Office:

James W. Chamberlin, engineering aide.

Charles E. Ijams, junior engineer, formerly in United States Engineer's Office, War Department.

Lewis Narrow, engineering aide, formerly in United States Engineer's Office, War Department.

Michael Spero, engineering aide, by transfer from the Navy Department.

Yakima, Roza Division:

Fred H. Schlien, junior engineer.

Deschutes:

James A. Dolphin, chief clerk, by reinstatement.

Boulder Canyon:

Norman J. Mittenthal, associate engineer, by reinstatement.

Central Valley:

William W. Buchtel, associate attorney.

Central Valley, Kennett Division:

Robert L. Gamer, junior geologist.

Transfers

To Denver:

Joseph B. Kalbfus, engineer, from Denver to Denver Office organization with headquarters at Birmingham, Ala.

Joseph Wilber Grimes, junior engineer, from All-American Canal.

William Lee Davis, Jr., junior engineer, from Parker Dam project.

To Parker Dam:

George W. Lyle, chief clerk, from Kendrick project, Wyo.

To Colorado-Big Thompson:

William Edward Green, associate engineer, from Moon Lake project.

Carl M. Voyen, chief clerk, from the Kendrick project.

To Truckee Storage, Boca Dam:

Carl H. Kadie, Jr., assistant engineer, from same position, All-American Canal project.

To Kendrick, Seminoe Dam:

Clinton D. Woods, associate engineer, from Parker Dam project.

To Central Valley, Kennett Division:

Robert R. Nicholas, assistant engineer, from the Parker Dam project.

Walter M. Enger, junior engineer, from the Parker Dam project.

Joseph J. Waddell, assistant engineer, from the Parker Dam project.

To Colorado River Investigations:

John J. Hedderman, assistant engineer, from the Salt River project.

Final Inspection of Salt River Spillways

(Continued from page 172)

difficulties encountered in constructing the tunnel, the outlet of which is about 150 feet below the inlet and which is 450 feet long with a 27° bend midway in the length. It is designed to bypass 50,000 second-feet if the need should arise.

At all of these dams the ordinary passing of irrigation water is through the turbines where, up and down the chain of lakes, there is a potential capacity of 1,690,000 kilowatt-hours per day. A great portion of this power is transmitted to the valley where powerful pumps bring infiltrated water again to the surface for irrigation. There are about 170 of these pumps distributed over the project. By their operation the project drainage problem is fully controlled.

The sun was just about to drop below the mountain tops when the party climbed aboard their cars and headed back to Phoenix. Everyone proclaimed the trip to have been a success in every way. On the way back to town, bits of conversation were heard here and there, indicating anticipation of a similar excursion to Bartlett Dam on the Verde River in the near future. This dam, of multiple arch design, is being constructed by the Bureau, on the repayment contract with the association to impound flood waters in the Verde until they can be gradually released for irrigation usage, thus conserving water storage on the Salt.

But regardless of the new work on the Verde, the Salt River Project governing boards and officials are entitled to a feeling of great relief, for they, with the aid and cooperation of the Bureau of Reclamation, have just made $32,000,000 worth of project works as safe from damaging floods as modern engineering can devise.

THE RECLAMATION ERA

THIS MAGAZINE is the official mouthpiece of the Bureau of Reclamation and is issued monthly.

There is no better way to keep posted on the activities of the Bureau than to read THE RECLAMATION ERA. You are invited to become one of our valued subscribers and for your convenience a blank subscription is printed at the bottom of this page for your use. Cut it off, attach your personal check or money order and you will commence immediately to enjoy reading about the operations of this major conservation organization of the Federal Government.

The contents of THE RECLAMATION ERA are designed to bring to its readers pictorially and by text, the subjects geographically distributed to feature the work of the Bureau of Reclamation and the effect of its operations locally and nationally. Engineers will be delighted with the space given to engineering subjects; contractors and materials men will find much of interest in the program of work outlined in the section designated "Notes for Contractors," and operation and maintenance questions and methods are treated, as well as the economics of irrigated agriculture.

Notices of foreign operations in the reclamation field also appear from time to time.

A sample copy of THE RECLAMATION ERA will gladly be furnished on request.

CONTENTS

THE RECLAMATION ERA • AUGUST 1938

CUT ALONG THIS LINE

COMMISSIONER, (Date) . . . .

Bureau of Reclamation,

Washington, D. C.

SIR: I am enclosing my check[1] (or money order) for $1.00 to pay for a year's subscription to THE RECLAMATION ERA.

Very truly yours,

August 1938 (Name) . . . .

(Address) . . . .

. . . .

[1] Do not send stamps.

NOTE.—36 cents postal charges should be added for foreign subscriptions.

U. S. GOVERNMENT PRINTING OFFICE: 1938

ADMINISTRATIVE ORGANIZATION OF THE BUREAU OF RECLAMATION

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E. K. BURLEW, FIRST ASSISTANT SECRETARY and Budget Officer (in charge of reclamation)

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Denver, Colo., United States Customhouse

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Projects under construction or operated in whole or in part by the Bureau of Reclamation

Project	Office	Official in charge		Chief clerk	District counsel	
		Name	Title		Name	Address
All-American Canal [1]	Yuma, Ariz.	Leo J. Foster	Constr. engr	J. C. Thrailkill	R. J. Coffey	Los Angeles, Calif.
Belle Fourche	Newell, S. Dak.	F. C. Youngblutt	Superintendent	J. P. Siebeneicher	W. J. Burke	Billings, Mont.
Boise	Boise, Idaho	R. J. Newell	Constr. engr	Robert B. Smith	B. E. Stoutemyer	Portland, Oreg.
Boulder Dam and power plant [1]	Boulder City, Nev.	Irving C. Harris	Director of Power	Gail H. Baird	R. J. Coffey	Los Angeles, Calif.
Buffalo Rapids	Glendive, Mont.	Paul A. Jones	Constr. engr	Edwin M. Bean	W. J. Burke	Billings, Mont.
Carlsbad	Carlsbad, N. Mex.	L. E. Foster	Superintendent	E. W. Shepard	H. J. S. Devries	El Paso, Tex.
Central Valley	Sacramento, Calif.	W. R. Young	Supervising engr	E. R. Mills	R. J. Coffey	Los Angeles, Calif.
Colorado-Big Thompson	Denver, Colo.			C. M. Voyen	J. R. Alexander	Salt Lake City, Utah.
Colorado River	Austin, Tex.	Ernest A. Moritz	Constr. engr	William F. Sha	H. J. S. Devries	El Paso, Tex.
Columbia Basin	Coulee Dam, Wash.	F. A. Banks	Constr. engr	C. B. Funk	B. E. Stoutemyer	Portland, Oreg.
Deschutes	Bend, Oreg.	C. C. Fisher	Engineer	James A. Dolphin	B. E. Stoutemyer	Portland, Oreg.
Fruit Grower's Dam	Montrose, Colo.	Clyde H. Spencer	Constr. engr	Ewalt P. Anderson	J. R. Alexander	Salt Lake City, Utah.
Gila	Yuma, Ariz.	Leo J. Foster	Constr. engr	J. C. Thrailkill	R. J. Coffey	Los Angeles, Calif.
Grand Valley	Grand Junction, Colo.	W. J. Chiesman	Superintendent	Emil T. Ficenec	J. R. Alexander	Salt Lake City, Utah.
Humboldt	Lovelock, Nev.	Stanley R. Marean	Superintendent	George B. Snow	J. R. Alexander	Salt Lake City, Utah.
Kendrick	Casper, Wyo.	H. W. Bashore	Constr. engr	George W. Lyle	W. J. Burke	Billings, Mont.
Klamath	Klamath Falls, Oreg.	B. E. Hayden	Superintendent	W. I. Tingley	B. E. Stoutemyer	Portland, Oreg.
Milk River	Malta, Mont.	H. H. Johnson	Superintendent	E. E. Chabot	W. J. Burke	Billings, Mont.
Fresno Dam	Havre, Mont.	H. V. Hubbell	Constr. engr	E. E. Chabot	W. J. Burke	Billings, Mont.
Minidoka	Burley, Idaho	Dana Templin	Superintendent	G. C. Patterson	B. E. Stoutemyer	Portland, Oreg.
Moon Lake	Duchesne, Utah	E. J. Westerhouse	Constr. engr	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
North Platte	Guernsey, Wyo.	C. F. Gleason	Supt. of power	A. T. Stimpfig	W. J. Burke	Billings, Mont.
Orland	Orland, Calif.	D. L. Carmody	Superintendent	W. D. Funk	R. J. Coffey	Los Angeles, Calif.
Owyhee	Boise, Idaho	R. J. Newell	Constr. engr	Robert B. Smith	B. E. Stoutemyer	Portland, Oreg.
Parker Dam	Parker Dam, Calif.	Howard P. Bunger	Constr. engr		R. J. Coffey	Los Angeles, Calif.
Pine River	Bayfield, Colo.	Charles A. Burns	Constr. engr	Frank E. Gawn	J. R. Alexander	Salt Lake City, Utah.
Provo River	Provo, Utah	E. O. Larson	Constr. engr	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah
Rio Grande	El Paso, Tex.	L. R. Fiock	Superintendent	H. H. Berryhill	H. J. S. Devries	El Paso, Tex.
Caballo Dam	Caballo, N. Mex.	S. F. Crecelius	Constr. engr	H. H. Berryhill	H. J. S. Devries	El Paso, Tex.
Riverton	Riverton, Wyo.	H. D. Comstock	Superintendent	C. B. Wentzel	W. J. Burke	Billings, Mont.
Bull Lake Dam	Riverton, Wyo.	Arthur P. Smyth	Resident engr	C. B. Wentzel	W. J. Burke	Billings, Mont.
Salt River	Phoenix, Ariz.	E. C. Koppen	Constr. engr	Edgar A. Peek	R. J. Coffey	Los Angeles, Calif.
Sanpete	Provo, Utah	E. O. Larson	Constr. engr	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
Shoshone	Powell, Wyo.	L. J. Windle	Superintendent [2]	L. J. Windle [2]	W. J. Burke	Billings, Mont.
Heart Mountain division	Cody, Wyo.	Walter F. Kemp	Constr. engr	L. J. Windle [2]	W. J. Burke	Billings, Mont.
Sun River, Greenfields division	Fairfield, Mont.	A. W. Walker	Superintendent		W. J. Burke	Billings, Mont.
Truckee River Storage	Reno, Nev.	Charles S. Hale	Constr. engr	George B. Snow	J. R. Alexander	Salt Lake City, Utah.
Umatilla (McKay Dam)	Pendleton, Oreg.	C. L. Tice	Reservoir supt		B. E. Stoutemyer	Portland, Oreg.
Uncompahgre: Repairs to canals	Montrose, Colo.	Denton J. Paul	Engineer [2]	Ewalt P. Anderson	J. R. Alexander	Salt Lake City, Utah.
Upper Snake River Storage [3]	Ashton, Idaho	H. A. Parker	Constr. engr	Emmanuel V. Hillius	B. E. Stoutemyer	Portland, Oreg.
Vale	Vale, Oreg.	C. C. Ketchum	Superintendent		B. E. Stoutemyer	Portland, Oreg.
Yakima	Yakima, Wash.	J. S. Moore	Superintendent	Philo M. Wheeler	B. E. Stoutemyer	Portland, Oreg.
Roza division	Yakima, Wash.	Charles E. Crownover	Constr. engr	Alex S. Harker	B. E. Stoutemyer	Portland, Oreg.
Yuma	Yuma, Ariz.	C. B. Elliott	Superintendent	Noble O. Anderson	R. J. Coffey	Los Angeles, Calif.

[1] Boulder Canyon. [2] Acting. [3] Island Park and Grassy Lake Dams

Projects or divisions of projects of Bureau of Reclamation operated by water users

Project	Organization	Office	Operating official		Secretary	
			Name	Title	Name	Address
Baker (Thief Valley division) [1]	Lower Powder River irrigation district	Baker, Oreg.	A. J. Ritter	President	F. A. Phillips	Keating.
Bitter Root [4]	Bitter Root irrigation district	Hamilton, Mont.	N. W. Blindauer	Manager	Elsie H. Wagner	Hamilton.
Boise [1]	Board of Control	Boise, Idaho	Wm. H. Tuller	Project manager	L. P. Jensen	Boise.
Boise [1]	Black Canyon irrigation district	Notus, Idaho	W. H. Jordan	Superintendent	L. M. Watson	Caldwell.
Frenchtown	Frenchtown irrigation district	Frenchtown, Mont.	Edward Donlan	President	Ralph P. Schaffer	Huson.
Grand Valley, Orchard Mesa [3]	Orchard Mesa irrigation district	Grand Jctn., Colo.	C. W. Tharp	Superintendent	C. J. McCormich	Grand Jctn.
Huntley [4]	Huntley irrigation district	Ballantine, Mont.	E. E. Lewis	Manager	H. S. Elliott	Ballantioe.
Hyrum [3]	South Cache W. U. A.	Wellsville, Utah	B. L. Mendenhall	Superintendent	Harry C. Parker	Logan.
Klamath, Langell Valley [1]	Langell Valley irrigation district	Bonanza, Oreg.	Chas. A. Revell	Manager	Chas. A. Revell	Bonanza.
Klamath, Horsefly [1]	Horsefly irrigation district	Bonanza, Oreg.	Henry Schmor, Jr.	President	Dorothy Eyers	Bonanza.
Lower Yellowstone [4]	Board of Control	Sidney, Mont.	Axel Persson	Manager	Axel Persson	Sidney.
Milk River: Chinook division [4]	Alfalfa Valley irrigation district	Chinook, Mont.	A. L. Benton	Vice President	R. H. Clarkson	Chinook.
Minidoka: Gravity [1]	Minidoka irrigation district	Rupert, Idaho	Frank A. Ballard	Manager	O. W. Paul	Rupert.
Pumping [1]	Burley irrigation district	Burley, Idaho	Hugh L. Crawford	Manager	Frank O. Redfield	Burley.
Gooding [1]	Amer. Falls Reserv. Dist. No. 2	Gooding, Idaho	S. T. Baer	Manager	Ida M. Johnson	Gooding
Newlands [3]	Truckee-Carson irrigation district	Fallon, Nev.	W. H. Wallace	Manager	H. W. Emery	Fallon.
North Platte: Interstate division [4]	Pathfinder irrigation district	Mitchell, Nebr.	T. W. Parry	Manager	Flora K. Schroeder	Mitchell.
Fort Laramie division [4]	Gering-Fort Laramie irrigation district	Gering, Nebr.	W. O. Fleenor	Superintendent	C. G. Klingman	Gering.
Fort Laramie division [4]	Goshen irrigation district	Torrington, Wyo.	Floyd M. Roush	Superintendent	Mary E. Harrach	Torrington.
Northport division [4]	Northport irrigation district	Northport, Nebr.	Mark Iddings	Manager	Mabel J. Thompson	Bridgeport
Ogden River	Ogden River W. U. A.	Ogden, Utah	David A. Scott	Superintendent	Wm. P. Stephens	Ogden, Utah.
Okanogan [1]	Okanogan irrigation district	Okanogan, Wash.	Nelson D. Thorp	Manager	Nelson D. Thorp	Okanogan.
Salt Lake Basin (Echo Res.) [3]	Weber River Water Users' Assn.	Ogden, Utah	D. D. Harris	Manager	D. D. Harris	Layton.
Salt River [2]	Salt River Valley W. U. A.	Phoenix, Ariz.	H. J. Lawson	Superintendent	F. C. Henshaw	Phoenix.
Shoshone: Garland division [4]	Shoshone irrigation district	Powell, Wyo.	Paul Nelson	Irri. superintendent	R. J. Schwendiman	Powell.
Frannie division [4]	Deaver irrigation district	Deaver, Wyo.	Floyd Lucas	Manager	Harry Barrows	Deaver.
Strawberry Valley [3]	Strawberry Water Users' Assn.	Payson, Utah	S. W. Grotegut	President	E. G. Breeze	Payson.
Sun River: Fort Shaw division [4]	Fort Shaw irrigation district	Fort Shaw, Mont.	C. L. Bailey	Manager	C. L. Bailey	Fort Shaw.
Greenfields division [4]	Greenfields irrigation district	Fairfield, Mont.	A. W. Walker	Manager	H. P. Wangen	Fairfield.
Umatilla: East division [1]	Hermiston irrigation district	Hermiston, Oreg.	E. D. Martin	Manager	Enos D. Martin	Hermiston.
West division [1]	West Extension irrigation district	Irrigon, Oreg.	A. C. Houghton	Manager	A. C. Houghton	Irrigon.
Uncompahgre [3]	Uncompahgre Valley W. U. A.	Montrose, Colo.	Jesse R. Thompson	Manager	H. D. Galloway	Montrose.
Yakima, Kittitas division [1]	Kittitas reclamation district	Ellensburg, Wash.	V. W. Russell	Manager	G. L. Sterling	Ellensburg.

[1] B. E. Stoutemyer, district counsel, Portland, Oreg.
[2] R. J. Coffey, district counsel, Los Angeles, Calif.
[3] J. R. Alexander, district counsel, Salt Lake City, Utah.
[4] W. J. Burke, district counsel, Billings, Mont.

Important investigations in progress

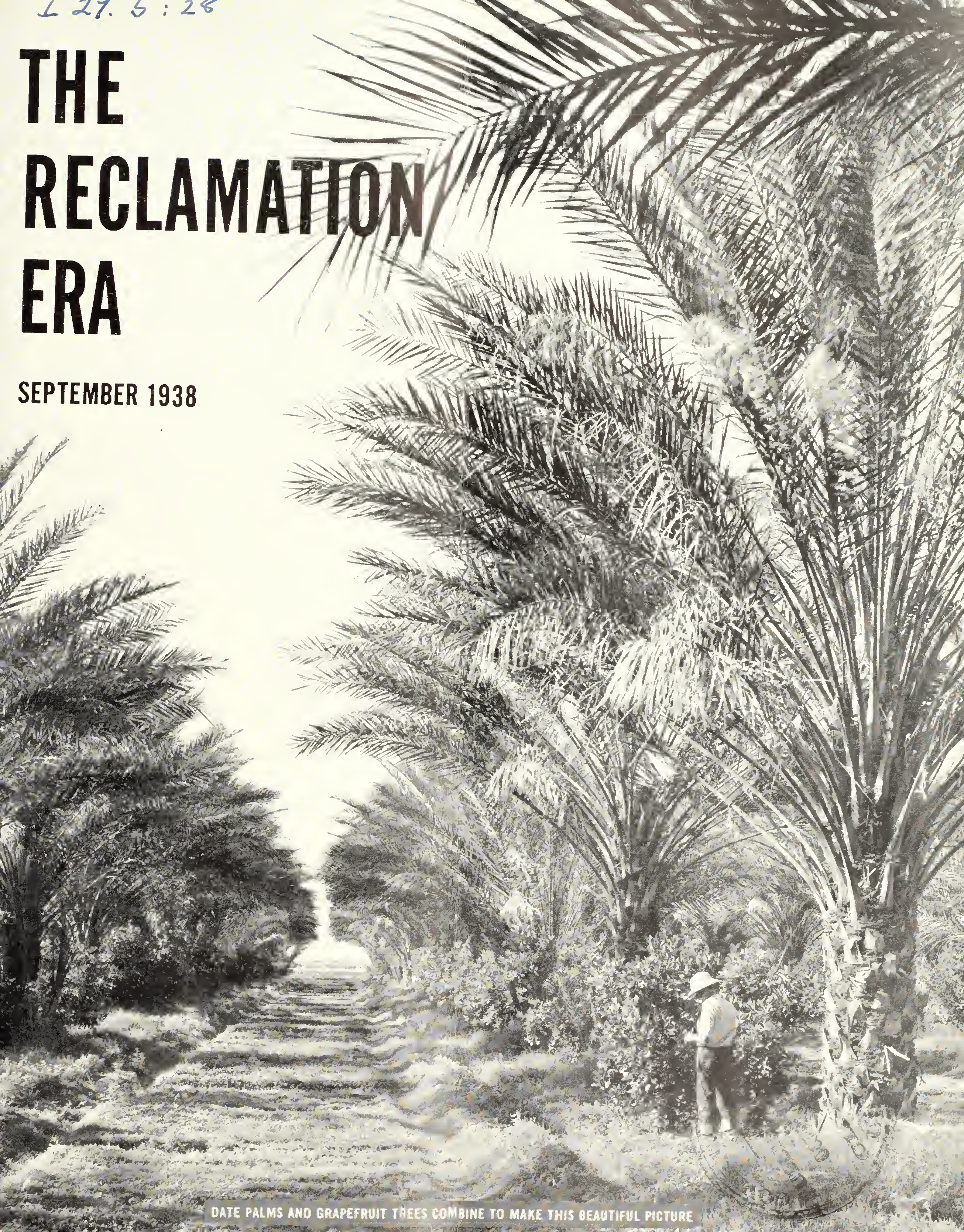
Project	Office	In charge of—	Title
Colorado River Basin, sec. 15	Denver, Colo.	E. B. Debler and P. J. Preston	Senior engineer
Boise-Weiser-Payette	Boise, Idaho	Lester C. Walker	Engineer.
Cabinet Gorge	Clarks Fork, Idaho	Wm. G. Sloan	Engineer.
Kenton and Fort Supply	Denver, Colo.	A. N. Thompson	Engineer.
Black Hills	Denver, Colo.	Denver Office	
Eastern Slope (Colo.)	Denver, Colo.	A. N. Thompson	Engineer.
Salt Lake Basin	Provo, Utah	E. O. Larson	Construction engineer.
Marias	Shelby, Mont.	Fred H. Nichols	Associate engineer.
Bear River Surveys	Salt Lake City, Utah	E. G. Nielsen	Associate engineer.

Issued monthly by the Bureau of Reclamation, Department of the Interior, as approved by the Director of the Budget. SALLIE A. B. COE, *Editor*.

DESILTING WORKS, ALL-AMERICAN CANAL; IMPERIAL DAM, UPPER RIGHT

THE RECLAMATION ERA

SEPTEMBER 1938



DATE PALMS AND GRAPEFRUIT TREES COMBINE TO MAKE THIS BEAUTIFUL PICTURE

Important Legislation

75*th* CONGRESS

AN AMENDMENT of prime importance to the Bureau of Reclamation was offered by Senator Hayden, of Arizona, to the Interior Department appropriation bill for the fiscal year ending June 30, 1939, when it was being considered on the floor of the Senate. This amendment embodies the content of the joint bill previously introduced by Senators Hayden and O'Mahoney. In effect 52½ percent of accumulated naval oil royalties are transferred to the credit of the Reclamation Fund. These total royalties amount to $56,625,000. That means $29,725,000 will be transferred to the Reclamation Fund. Under the law $15,000,000 will be applied to retiring a Treasury loan to the Reclamation Fund and the balance of $14,725,000 will be available for the Bureau's construction program.

The greatest benefit to the Reclamation Fund will be derived from operations under the following clause:

> "All moneys received by the United States in connection with any irrigation projects, including the incidental features thereof, constructed by the Secretary of the Interior, through the Bureau of Reclamation, and financed in whole or in part with moneys heretofore or hereafter appropriated or allocated therefor by the Federal Government, shall be covered into the Reclamation Fund * * *."

This will amount to approximately $350,000,000. This sum, unlike the naval oil lease moneys, will not be an immediate income to the Reclamation Fund. Benefits will accrue as soon as payments are commenced under the repayment and power contracts made on such projects.

This legislation in effect acts as a substitute for the diminishing revenue from the sale of public lands, oil royalties, and other resources, provided in the original Reclamation Act of June 17, 1902, and amending legislation.

JOHN C. PAGE, *Commissioner.*

PRICE
ONE
DOLLAR
A YEAR

THE RECLAMATION ERA

VOLUME 28 • SEPTEMBER 1938 • NUMBER 9

Expedition Including Women Safely Navigates Colorado River

By RUPERT B. SPEARMAN, *Assistant Engineer, Boulder City, Nev.*

THE NEVILLS EXPEDITION, the first party including women successfully to navigate the dangerous rapids of the Colorado River, arrived upon the still waters of Lake Mead on July 21. With them they brought stories of thrills, adventure, and the determination to do it again which will not be forgotten.

The party included Miss Elzada Clover, University of Michigan botany instructor; Miss Lois Jotter, graduate student at the University of Michigan and assistant to Miss Clover; Norman D. Nevills, veteran river man of Mexican Hat, Utah; Eugene Atkinson, University of Michigan zoologist; Don Harris, employee of the United States Geological Survey; and W. C. Gibson, San Francisco artist and photographer. Mr. Nevills, an expert boatman, getting most of his experience on the San Juan River, organized the expedition and was its chief throughout the trip.

To the two women in the party, Miss Clover and Miss Jotter, goes the honor of being the first women to successfully complete a trip down the Colorado River by boat. The last woman to try was Mrs. Glenn R. Hyde, who, with her husband, was lost somewhere in the Grand Canyon 10 years ago.

The expedition was organized for the purpose of obtaining specimens of plant life by the members of the University of Michigan faculty; studies of early races of people who lived along the river by Norman D. Nevills, who has done creditable archeological work in southeastern Utah; and also for the adventure.

Three boats, named the *Mexican Hat*, *Botany*, and *Wen*, were used. The *Wen* was named in honor of W. E. Nevills, father of the organizer of the expedition. The boats, which are 16 feet long each with a 6-foot beam, are especially designed for running rapids of the type found in the canyons of the Colorado River. In their construction, a five-ply wood with a special water seal between each layer was used for covering the frame of the boat. Ply wood had not been used heretofore for the construction of boats to run rapids. All members of the party gave much of the credit for the success of their voyage to the design and construction of their boats.

The trip was started from Green River, Utah, on June 20, with the first stop for supplies at Lees Ferry on July 8. Here two members of the party, Don Harris and Eugene Atkinson, were unable to continue, Mr. Harris because of a transfer, and Mr. Atkinson to resume his studies in another part of the country. Loren Bell, of Tuba City, Ariz., and Dell Ried, of Mexican Hat, Utah, joined the party as boatmen, and on July 13 they were again on their way with the next stop in the Grand Canyon at Bright Angel on July 18. At Bright Angel Emery Kolb, veteran boatman on the Colorado River, joined the party as a guest and made the trip from there on. It was Mr. Kolb's third trip through the Grand Canyon, although he had made numerous short trips in the canyon.

Front row, left to right: W. C. Gibson, Dr. Elzada Clover, Lois Jotter, Loren Bell
Back row: Del Ried, Norman D. Nevills, Emery Kolb

Courtesy National Park Service

Expedition at Emery Falls, now partially covered by Lake Mead

In the afternoon of July 21 the expedition arrived on the quiet waters of Lake Mead. On August 1 they were met at Emery Falls, about 5 miles above Pierces Ferry, by a party consisting of Congressman J. G. Scrugham, officials of the National Park Service, Grand Canyon-Boulder Dam Tours, Inc., Mr. Gibson's wife, mother, and father, representatives of the press, and others, of whom the writer had the honor of being a member. We traveled in a large launch owned by Grand Canyon-Boulder Dam Tours, Inc. In the welcoming party was Buzz Holmstrum, the first *lone* boatman to navigate the Colorado River. Mr. Holmstrum completed his trip from Green River, Wyo., to Boulder Dam on Thanksgiving Day of last year. Buzz, as everyone calls him in Boulder City, is now working as a boat pilot on Lake Mead for the Grand Canyon-Boulder Dam Tours Co. The members of the expedition were brought down the lake on the launch with the boats towed behind.

Thrills and Excitement

This happy group had many interesting stories of thrills and excitement to tell. Of the many they experienced, they all agree that the following were the high points of the trip:

Upon arriving at the head of the first rapids in Cataract Canyon, 4 miles below the junction of the Colorado and Green rivers, the boats were beached and the four men of the group walked along the shore a short distance to study the rapids and secure pictures of an inscription left by Major Powell's expedition. The river was flowing approximately 50,000 cubic feet per second, and in normal water there would have been space between each of the Cataract rapids for further study, but during the floods the separate rapids are practically as one. While looking out over the river, Don Harris glanced up to discover, to his amazement, one of their boats, the *Mexican Hat*, had broken loose and was then heading toward the rapids in midstream. Harris rushed back to the other boats, and with Miss Jotter started out after the fast-disappearing boat in the boat *Wen*. Harris and Miss Jotter ran six rapids in something like 9 minutes, covering a distance of approximately 2¼ miles, before they found a spot where they might stop on the shore and look further for the lost boat. After walking down the beach from the point where they had tied the *Wen*, they found the *Mexican Hat* in an eddy right side up and undamaged. This adventure ended with Miss Jotter spending the night with the two boats downstream, while Harris returned up the river to inform the remainder of the party of their good fortune. He was able to get close enough to signal that all was well, but he could not get dry clothing, and it was impossible, because of darkness, to return to the two boats where Miss Jotter had made camp. Wearing only a pair of pants, and those soaked, he spent an uncomfortable night.

After this experience they spent 4 days lining one or two rapids and portaging their boats and equipment 100 yards. It was necessary that they haul their boats up a 45° angle for 60 feet and then pull them over rocks for the distance of approximately 100 yards.

At mile 23 rapids they experienced their second greatest thrill on the trip. The party traveled in order with Nevills and Miss Clover leading, Atkinson and Gibson following them, and Don Harris and Miss Jotter in the third boat. Here, in mile 23 rapid, Atkinson and Gibson's boat made a front

Party in Granite Gorge after reaching the quiet waters of Lake Mead

flip, in a mushroom wave, landing upside down and throwing both men into the river. Atkinson regained the boat by catching the mooring rope, while Gibson was picked up by Harris and Miss Jotter. Nevills and Miss Clover caught the overturned boat carrying Atkinson, and in an attempt to beach both boats, Nevills lost his grip on the mooring rope, after jumping to shore; and the two remaining, Miss Clover and Atkinson, were carried through approximately 4 miles of rapids before they were able to stop. Here, although Nevills did not tell the remaining members of the party until later, he firmly believed they had lost two of their boats, even though he felt Miss Clover and Atkinson would reach shore safely; and he was relieved when hours later they caught up with Miss Clover and Atkinson.

Before reaching Lees Ferry the party made a side trip to Rainbow Bridge, a hike of about 6 miles. After leaving Lees Ferry they experienced exciting and dangerous moments. In the Grand Canyon they were in one of the Canyon's famous cloudbursts with its brilliant display of lightning.

Of approximately 300 rapids to negotiate one way or another, only one important portage, the one previously described was made and six rapids were lined. To line a rapid means to handle the boat from shore by ropes.

The expedition holds the record of being the first party to make the trip without injury to its members or loss of equipment.

Photographs were taken of the trip by various members of the expedition. Mr. Gibson shot hundreds of feet of 16 millimeter movie film, in both natural color and black and white. A detailed journal of the trip was also made in which all events of the trip were recorded. A book on the expedition is to be prepared by Miss Clover and Norman Nevills.

Mr. Nevills has already definite plans for another trip next year, which will begin at Green River, Wyo., instead of Green River, Utah. Miss Clover plans to be one of the members of this expedition, and Miss Jotter expressed a sincere desire to be along, too, when they pull out into the river, but states she must spend the summer on her studies.

Columbia Basin Camp Improvement

IMPROVEMENT work in Mason City, the contractor's camp on the Columbia Basin project, which has been under way for the past 5 months, is nearing completion. Painting is still in progress. All public buildings have been remodeled and many improvements added; streets have been surfaced with an oil-mix paving; six new residences, a gymnasium, high-school building, and service station have been erected, and much landscaping has been done. These improvements have added much to the general appearance and serviceability of the town.

Miss Lois Jotter, left, and Dr. Elzada Clover enjoy box lunch on motor launch

Large Earth-Fill Dams on Federal Reclamation Projects

CONSTRUCTION has just been commenced of two outstanding earth-fill dams, each of which will contain more than 3,000,000 cubic yards of material and exceed the two dams of this character that have heretofore held the record with about 2,000,000 cubic yards of material each.

The four dams mentioned are as follows:

UNDER CONSTRUCTION

Name	Project	State	Maximum height	Volume
			Feet	*Cu. yds.*
Vallecito Dam	Pine River	Colorado	125	3, 200, 100
Deer Creek	Provo River	Utah	150	3, 000, 000

COMPLETED

Name	Project	State	Maximum height	Volume
McKay	Umatilla	Oregon	165	2, 287, 000
Tieton	Yakima	Washington.	222	2, 038, 000

The Vallecito Dam is located on Pine River in southwestern Colorado, about 20 miles northeast of Durango. It will form a reservoir with a capacity of 126,000 acre-feet for the irrigation of more than 67,000 acres of land. The dam consists of a rolled-earth embankment with rock fill on the downstream slope, with a crest length of 4,000 feet and a top width of 35 feet.

The Deer Creek Dam, located on the Provo River about 13 miles northeast of Provo, Utah, will form a reservoir with a capacity of 147,000 acre-feet for furnishing a supplemental water supply to 36,000 acres of land in Utah and Salt Lake Valleys. The dam consists of clay, sand, and gravel fill, with concrete cut-off wall and 3-foot rock riprap face.

New Map Available

A REVISED EDITION of the map of the Shoshone project, Wyoming and Montana, has been issued by the Bureau of Reclamation, which may be obtained upon application to the Bureau, payment to be made in advance by check or money order drawn to the Bureau of Reclamation. *Postage stamps are not acceptable.*

No. 38–130 (1938). Colored; size 10½ by 15½. Price, 10 cents each.

No. 38–130A (1938). Colored; size 20 by 29¾. Price, 25 cents each.

Belle Fourche Bird Refuge

THE Bureau of Biological Survey has pleted in June. For a period of approxi- of the Belle Fourche Reservoir, Belle Fourche project, South Dakota, as part of the plan to develop a bird refuge and nesting grounds.

Construction of Fresno Dam

By H. V. HUBBELL, *Construction Engineer*

ORIGINAL PLANS for the irrigation system of the Milk River project contemplated a storage and regulating reservoir on the Milk River near Havre, Mont. This reservoir was formerly planned to be constructed in the old channel of the Milk River about 40 miles upstream from Havre. This old channel is a series of lakes, and the name, Chain of Lakes Reservoir, was derived therefrom.

Extensive investigation of various dam sites in 1933 to 1935 led to the selection of a site for the dam across the Milk River approximately 2 miles northeast of Fresno, Mont., and the name was changed to Fresno Dam.

For years the Milk River project has been operated with no control of the waters, turned into the Milk River from the St. Marys Canal near Glacier Park, for a distance of 325 miles to the Lohman Dam near Chinook, Mont. Such operation required 6 to 10 days for control of the water from St. Marys storage to be effective on the project. This operation was wasteful and unsatisfactory for irrigation needs of the project. The construction of Fresno Dam will create a storage of 128,000 acre-feet and furnish control of the river near the point of use. It will also tend to reduce the menace of flash floods in the river below and make much of the lowlands along the river safe for farming.

Fresno Dam, an earth fill structure across the valley of the Milk River, has a width of 2,100 feet on the crest and 1,600 feet across the river bottom. The height of the dam above the river channel is 77 feet, the crest of the spillway being 20 feet below the top of the dam. The bottom width parallel with the river is approximately 700 feet and the top width 35 feet. The spillway located in the sand rock and shale at the left abutment is 210 feet wide and 20 feet deep at the crest. It is designed for a discharge of 52,000 second-feet. The spillway will be surmounted by a steel truss bridge having a clear span of 210 feet and a width of 18 feet. Control and outlet works consist of a trash-rack structure at the upper end of a 12-foot diameter horseshoe tunnel under the left abutment. At about two-thirds the length of the tunnel from the upstream end will be located a gate chamber containing two 4- by 6-foot emergency gates. From these gates two 6-foot diameter pipes carry the water through a section of semicircular tunnel 18 feet in diameter to the control house at the lower end of the tunnel, where the regulating gates will be housed. All gates are operated by oil pressure from the control house.

Construction Begun May 27, 1937

Contract for construction of the Fresno Dam was awarded November 27, 1936, to The Wachter-O'Neil Construction Co. and Megarry Bros. of Bismarck, N. Dak., the low bidders for the work. Actual start of operation was begun by the contractors May 27, 1937.

The work on the dam to July 15, 1938, consisted of stripping the area for earth embankment, construction of the rock fill near the lower toe of the dam, placing the drain along the toe of the rock fill except for the river channel, excavation of cut-off trench to the right of the river and partial excavation of the trench on the left of the river. The outlet works are completed, except for the placing of gates and equipment and construction of the control house. The walls of the spillway at the lower end are completed to above high water and the floor below the crest is 90 percent completed.

The stripping of the foundations for the earth fill offered no particular difficulties. The abutments were stripped to solid material by dozers and the material picked up at the bottom of the slope by shovels. LeTourneau carry-all scrapers pulled by tractors stripped the river bottom. A few low places to the left of the river were too soft for the machinery and were left until after the effect of dewatering the foundation.

The rock toe was constructed of material from the spillway excavation. On account of the nature of the rock excavated, which consisted of large potato-shaped boulders embedded in a very soft sand rock and which could not be broken to give enough fine material to make a suitable fill, it was necessary to issue an extra work order to break the rock into sizes less than 1 cubic yard, and also another extra work order to furnish and sluice gravel into the voids of the rock. A fill of this material approximately 80 feet wide and 3 feet deep was constructed and the toe drain placed at the lower edge of this fill. The balance of the rock fill was built up of the material excavated from the spillway. As there was an excess of material from the spillway excavation, it was placed downstream from the rock fill section to give additional weight. The portion of this fill and drain across the river channel will be constructed after diversion of the river.

Fresno Dam from below spillway, showing water from tunnel after diversion, July 13, 1938

Excavation Work

The excavation of the cut-off and drainage trench near the upstream toe of the fill was begun April 7, 1938. This trench is being constructed in two sections. The trench to the right of the river has been completed and excavation is being made on the section to the left of and including the river channel. Two lifts of well points were used in dewatering the river sand and silt for performing the excavation. The first set of points dewatered for excavation to approximately 20 feet in depth and the second set allowed excavation to the full depth of 30 feet. Lenses and layers of clayey material offered considerable difficulty in the lower lift, as the well points were not effective in the clay. Many offset well points laid horizontally on top of clay strata and covered with sand and gravel were used to stop the flow into the trench. After the trench was excavated, drains of perforated corrugated metal pipe were laid in gravel along each side of the trench and discharge was made into a sump near the river from which the water was pumped into the river. The very fine material in the excavation made it necessary to make a filter of sand retained on a No. 28 mesh screen between the gravel and the material in the sides of the trench. It was also necessary to carry the gravel to considerable height up the sides of the trench in places where the water would run in after the lower points were shut off after partially filling the trench with compacted embankment. After the drains were placed, compacted embankment was constructed in the trench on a very flat slope toward the operations of excavation and laying drains. The lower sets of well points were removed as the fill reached the elevation of the header and re-used ahead of the excavation. Approximately ½ second-foot of water was pumped from the 950 linear feet of trench to the right of the river after the drains and compacted fill had been placed.

Subcontract Work Completed

The outlet works were subcontracted by the general contractors to Smith, Spehn & Klies, of Great Falls, Mont. Work was begun by the subcontractors April 7, 1937, and completed July 9, 1938. The material encountered in the tunnel was chiefly a very firm sandy shale. There was soft sand rock near the top of the tunnel for a short distance from the upper portal. The shale disintegrated rapidly on exposure to air, and it was sprayed with coal tar paint to prevent disintegration. It was evident that liner plates were necessary at least in the arch of the horseshoe tunnel, and as the tunnel progressed it was decided that liner plates would be required throughout the tunnel. The contractor was, therefore, ordered to place liner plate for the full length of the tunnel. Conditions in the gate chamber indicated the necessity of heavy supports and a structural steel frame covered with corrugated metal sheets was designed and an extra work order issued for its construction. Concreting was done by means of a pumpcrete machine located at the upper portal of the tunnel. Owing to the lack of space in the arch of the horseshoe tunnel for use of the pumpcrete pipe, the arch of the tunnel was lowered 3 inches. The concrete lining was heavily reinforced and made concrete placing very difficult. Concrete was placed in 24-foot sections, except on curves. After concreting, the tunnel was grouted through pipes set in the arch before concreting, using a grout composed of fine river sand and cement with a ratio of 4 : 1. After grouting with this to a pressure of 30 pounds per square inch, the vertical holes were redrilled to 7 feet vertically from the inside of the concrete, and neat cement grout was forced into them at a pressure of 40 pounds per square inch to fill any arch settlement cracks in the rock. Holes were also drilled at 50-foot intervals in the sides of the horseshoe tunnel and grouted to 60 pounds pressure. After this grouting had been completed, holes were drilled in the center of each concrete pour in the horseshoe tunnel up to the liner plate and neat cement grout was forced into them at a pressure of 60 pounds per square inch.

Excavation for the spillway was begun April 2, 1937. Two shovels of 1¾ and 2 cubic yards' capacity were used on this work, and the material from the excavation was hauled into the rock fill and earth blanket at the toe of the dam. The material was soft sand rock with embedded boulders for the portion above elevation 2530 and sandy shale below, except at the lower right corner of the stilling pool, which was river sand, and it was necessary to use well points to dewater this portion below the river level. This river sand extended under the original designed lower right cut-off wall and necessitated changing the vertical cut-off wall to a warped wall. Hydraulic tests of the model also caused the changing of the left cut-off wall to a warped wall extending farther downstream. Concreting of the spillway was begun July 19, 1937, and on November 1 of the same year all concrete in the stilling pool up to above high water had been placed. The foundation material in the soft sand rock disintegrated to some extent, and there were sand pockets and holes from which boulders had been removed which required either the using of considerable excess concrete or stabilizing the material with asphalt. The latter method was used. The low spots were dug out and the material was mixed with emulsified asphalt and tamped back in place. This method proved quite satisfactory. On account of the very dry condition of the sand rock and its avidity for water, the rock surface was sprayed with the asphalt emulsion before concreting to prevent absorption of moisture from the concrete. Work of concreting the spillway was started again in the spring of 1938, and except for the right walls near the crest, which are not to be concreted this year on account of possible sloughing of the hillside, will be completed in September of this year.

River Diverted

The river was diverted through the tunnel July 13, 1938. This will allow immediate construction of the rest of the cut-off and drainage trench under the dam after which the placing of earth fill will be started with full equipment. Material for the earth fill will be obtained from borrow pits on top of the left abutment. The material is being irrigated in the borrow pit by pumping from the river. Experiments have shown that it is practical to moisten at least 15 feet in depth by irrigation. The borrow pits are dyked in sections and the water sufficient to properly moisten the section is applied. In general, it takes 2 to 3 months for the moisture to penetrate to 15 feet. The material will be placed on the dam by trucks. It will be spread by dozers to a depth to make layers 6 inches deep after rolling. Compaction will be done by sheep-foot rollers.

The work on the contract was approximately 40 percent completed on July 1, 1938. Most of the work preparatory to the placing of the earth fill had been completed and it is expected that this portion of the work will be the main facture during the next year.

The following are estimated quantities of the principal items of work on the project:

	Cubic yards
Earth fill	1,725,000
Rock riprap	50,000
Concrete	15,000
	Pounds
Reinforcing steel	1,730,000
Gates and miscellaneous metal work	530,000
Bridge steel	190,000

The time for completion of this work in accordance with the contract and change orders is May 25, 1940.

Humboldt Project Crops Good

HARVESTING of the first crop of alfalfa on the Humboldt project, Nevada, was completed during July, the yield being unexpectedly good in most cases, and in spite of stormy weather during the forepart of the month, most of the hay harvested was stacked in good condition. The harvesting of barley and wheat was started during the last few days of the month, and except in a few instances where smut has resulted from the cold and damp weather conditions, the wheat crop promises a satisfactory yield.

Sugar beets have made splendid growth on the trial acreages that have been put in by sugar-beet interests. The outlook for a good and high quality yield is encouraging.

CONCRETE MANUAL NOW AVAILABLE

A NEW handy and valuable technical book, the Concrete Manual, has just been issued by the Bureau of Reclamation and is now available for sale to the public at either the Washington, D. C., or Denver, Colo., office.

The Concrete Manual contains 454 pages and a number of illustrations, charts, graphs, and diagrams.

The manual was compiled in the office of the Chief Engineer, and into it went the research, the knowledge, and the technique developed by the Bureau of Reclamation in its construction program, which has included the placing of more than 13 million cubic yards of concrete in about 150 dams and in thousands of canals and irrigation structures on Federal reclamation projects.

The price of the manual is $1 per copy, postage free, in the United States, Canada, and Mexico; and $1.25, including foreign postage, elsewhere. Orders will be received by the Commissioner, Bureau of Reclamation, Department of the Interior, Washington, D. C., or by the Chief Engineer, Bureau of Reclamation, United States Customhouse, Denver, Colo., and should be accompanied by payment, as this facilitates their handling. Payment should be made by check or money order, drawn to the Bureau of Reclamation, and, in the case of foreign orders, by international money order drawn in like manner.

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THE RECLAMATION ERA • SEPTEMBER 1938

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COMMISSIONER,
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SIR: I am enclosing my check[1] (or money order) for $1.00 to pay for a year's subscription to THE RECLAMATION ERA.

Very truly yours,

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Water and the Land

By S. H. McCRORY, *Chief, Bureau of Agricultural Engineering, Department of Agriculture*[1]

WATER and the land together form our most necessary resource. On man's skill in their use will his future largely depend. On an occasion such as this it is perhaps proper to consider the broader aspects of their combined use for agriculture, the accomplishments to date, and the immediate needs, and endeavor to forecast the future.

In general, the location of our land is fixed, although degradation is slowly changing its contour and boundaries. With our present knowledge and equipment only infinitesimal changes can be made in land masses, but changes such as those caused by erosion may vitally affect mankind.

Water used by man in his daily work has its origin in rain and snow. Its distribution over the land masses varies greatly. In regions of scanty rainfall irrigation becomes necessary. Where there is an excess of precipitation drainage is required if the lands are to be used for agriculture. Distribution of rainfall also has an important effect on the kinds of plants that grow in a given region. When man begins to cultivate the land, erosion, caused by wind and water, often becomes a serious problem. What, then, can man do to make the situation in regard to water and the land more favorable for his use? At present, when water is lacking for agriculture, we can, in some places, irrigate. Where there is too much we can drain, and we can so control the water that falls upon the land as to greatly reduce erosion or the accumulation of alkali. It sounds simple, but in reality is a very complex relationship, for as our civilization has developed other uses than agriculture have grown up for land and water, and in planning for their use we must take into account not only the needs of agriculture but of municipalities, power plants, wildlife, recreation, and so forth.

In the West, where we are today, the first thought and emphasis are upon water.

Early Irrigation

When, in July 1847, the Mormon pioneers arrived in Utah and camped on the banks of what is now City Creek, they plowed a furrow to lead the water out upon the parched lands. Then was born the modern land and water relationship. There are evidences in New Mexico, Arizona, and elsewhere in the great Southwest that primitive man had been irrigating these lands for hundreds of years. Here in California the Spanish padres had produced food for humans, and possibly for animals, long before the West had been invaded by the American explorer. Long before the settlement of Utah primitive man had been driven off the irrigated fields in the Southwest by alkali accumulations.

Since the memorable day 91 years ago in Utah when the big ditch or canal was measured by the number of plow furrows, water and land use in the West have gone forward with gigantic strides. The magnificent Boulder Dam and All-American Canal are only measures for today, and it is hard to conceive what may be undertaken tomorrow. The All-American Canal alone will carry enough water to irrigate an area four-fifths as large as all of the land now irrigated in Utah.

From a handful of people in 1847, there is now being supported by land and water use most of the population of the arid States and in much of this area agriculture is possible only through irrigation.

Value of Irrigation Works

In the realm of investment, the figures are staggering for so young a country. They ran well over a billion dollars in 1930. According to the census of 1930, the value of irrigation works in Utah was nearly $40,000,000. The cost of the aqueduct leading water from the Colorado River to the Metropolitan Water District of Southern California for domestic and irrigation purposes is more than five times this sum. This is capital investment in the conduit only. Indeed, land and water use costs are mounting, and as water becomes scarcer these costs will go higher.

Source of Water Supply

Of the land surface of the West only about 2 percent is in irrigated farms and this 2 percent of the land in many arid States makes use of most of the water falling upon all the land. Many of us who have seen irrigated lands and irrigation ditches consider the river or the reservoir from which the water is diverted as the source of the water. In reality, the water of summer and late season comes from the mountainous areas of the watersheds. The mountanous areas, which contribute the late July, August, and September irrigation water, are probably only about 10 or 12 percent of the entire land area of these States. These catchment areas are the reservoirs from which come the life-giving streams. In many of the so-called reserves of the West, lands as well as forests are managed and operated for water yield as the greatest asset. Thus, the lands to be irrigated in San Bernardino County by the Boulder Dam Aqueduct are several hundred miles from the water source. The production, improvement, and management of these watershed areas are land-use and water-use problems.

Preferential Water Rights

Because water is a scarce necessity in the arid region, practically all of the Western States have recognized the use of water as a public benefit. Most of the Western States declare in their constitutions that all waters within the State are the property of the State, to be held in trust for the use of its citizens. Various laws, in addition to the constitutional provision, indicate the public nature of water use, and the courts, both State and Federal, have upheld such laws. In practically all States, and especially in the arid States, there are preferential water rights. First come those for human use, including the production of food, then those for industry, mining, recreation, wildlife. In most of the Western States the constitution provides also that the measure and basis of a water right is beneficial use.

A water right is an important and valuable piece of property in arid sections. Water rights are acquired by applying to the State engineer or other designated State official, and upon completion of the works incident to the use of this water right the applicant is granted a permit, or water right. This guarantees to him the enjoyment of the water so long as he makes beneficial use of it. If he fails to use the water for a stated period, varying with the different States, the right is declared abandoned and the water again becomes public property subject to appropriation. A change in use or a change in the point of diversion is possible only by applying for and receiving a permit from the State engineer.

In the early days the settlers had little in the way of funds or equipment, and ditches were built where the cost would be at a minimum and usually with little regard to the quality of the land that was to be irrigated. Thus, the lower-lying ditches were first built. As additional settlers came, a ditch at a little higher elevation was constructed and thus we find in the older irrigated valleys many paralleling ditches. In the first part of this present century the Federal Reclamation Act was passed primarily for the purpose of bringing into cultivation

[1]Address delivered before the 32d annul meeting of the American Society of Agricultural Engineers, at Asilomar, Pacific Grove, Calif., June 28, 1938.

he public domain of the West. Many of the earlier projects were located without sufficient regard to the quality of the land to be farmed and with primary consideration for the engineering features. As time went on and difficulties arose, both in private enterprises and in Federal undertakings. Lands became waterlogged, alkaline, and in some cases entirely unproductive. As a remedial measure, drainage was undertaken, and just recently careful attention has been paid to the land proposed to be brought under irrigation. Today we find drainage systems planned to be put in along with the irrigation systems, the idea being to prevent difficulties rather than to cure them.

Efficient Use of Water

In the early days the water requirement of irrigated lands was determined by ascertaining the amount of water used by the better farmers. No attention was paid to the effect of the quantity of water so used or the fertility of the soil or its physical behavior. Research studies were inaugurated to determine the water requirements of various plants grown upon various soils and under different climatic conditions. Today we study the plant requirements for water, the total amount of water needed in applying this amount to the plants, and, finally, the additional quantity of water that may be needed to control alkaline accumulations. These studies have also shown how to use the water more efficiently and thus irrigate a larger area with the same supply.

When water was more plentiful and the irrigated acreage was much less there was little need for data that would give the dependable water supply of a stream. Systematic measurements of various western streams were undertaken even in the last century by both the Federal and State Governments. Today we have a record which, for the major streams, extends back over a number of years and gives us averages, maximums, and minimums of stream flow, all referring to the past. The severe droughts of the past 6 or 7 years have indicated the value of knowing in advance the water supply that may be anticipated during the season for crop production. Spasmodic attempts were made during the past 35 years to predict the season's water supply by measurement of the snow cover in the mountains. California, Nevada, Oregon, and Utah had made considerable progress in this work when, in 1934, the Bureau of Agricultural Engineering obtained funds for the purpose of correlating the present snow-survey activities and extending the work into other areas. Since that time, with the assistance of the States and other agencies of the Department, we have made a good beginning in establishing snow-survey courses in the watersheds that supply water to the irrigated areas of the West, and information on snow cover is exchanged with Canadian officials, especially on the Columbia River watershed. Where we have had the advantage of actual measurements of river flow as a check, the forecasts based on the snow surveys have been proved surprisingly close—98 and 99 percent accurate in two cases of peak-flow measurement.

In the first efforts to predict the water supply only the depth of snow was determined. Since the water content of snow varies from 2 to 6 inches of water per foot-depth of snow, it is readily understandable why early efforts were not very successful. The present method is to determine the water content of the snow cover, correlate this with the stream flow, and thus provide a basis from which to predict not only the season's water supply but its distribution throughout the season.

In the more populous areas of the West there is a continuous battle over water for municipal and agricultural uses. Thus we find subdivisions constantly encroaching on agricultural areas.

The problems of agriculture are complicated by increased valuations and its attendant tax rate, as well as having to compete with an increased water rate due to the proximity of domestic service, which can always afford a much higher price. Fortunately the two uses require about the same volume of water, so that the transition does not affect the areas served.

In many inland valleys which are entirely dependent on ground water as a source of supply there is one serious aspect of this transition from agriculture to urban or city use. As buildings are erected, streets and sidewalks paved, less and less of the rainfall percolates into the soil, since more of it is led off into storm sewers and wasted into the ocean.

In what has been stated, an attempt has been made to give a rough picture of the continuous fight between conflicting uses for land and water as well as the ever-mounting difficulties of obtaining a supply of water and the increasing cost.

In the improvement and protection of the watersheds; in the building of the dams, canals and ditches; in the leveling of the land; in the plowing, planting, tillage, and harvesting of crops; and in the conveyance of these crops over long distances, are presented a variety of problems necessitating new and improved types of machinery and tools. There are diseases and pests requiring control that differ from those prevalent in the humid regions. New soil problems are encountered as well as different types of farming and stock raising.

Need for Improved Drainage

Drainage in some form is needed in both humid regions of the East and in the irrigated regions. Much of our best agricul-

Newlands project, Nev. Lahontan Reservoir spills. For the second time since Lahontan Dam on the Carson River, Nev., was completed in 1915, the storage reservoir filled to overflowing this summer. The reservoir has a capacity of 293,600 acre-feet

tural land east of the 100th meridian would be of little value without drainage. Some 84,000,000 acres has been included within organized drainage districts and works costing more than $680,000,000 have been constructed. There remains much work to be done which would make existing drainage work better. In many districts improved outlets are needed. These frequently handle the run-off from large areas and are expensive to construct. Perhaps the most pressing need in the field of drainage is improvement in the maintainance of drainage works. Neither the methods of maintenance nor the organization for providing the funds and doing the work have in general functioned well. The work of the CCC drainage camps has done much toward developing methods for this type of work. The job is admittedly difficult and offers a fertile and promising field for study. From data compiled by the National Resources Board and from soil surveys, it has been shown that 77 percent of the more than 16,000,000 acres of land in organized drainage districts in Iowa is classified as "excellent," or "good," indicating the successful functioning of the drainage improvements. Much has been done to improve the drainage of our agricultural land as shown by the 84,000,000 acres in drainage districts, just mentioned, and much tile has been laid, probably around 60,000 miles of it in the 35 drainage States. In the West great progress has been made in developing methods of draining irrigated land.

In the early days drainage works were put in by hand or with teams. As the Middle West was settled, the demand for larger ditches forced the development of the dipper dredge. By 1906 the demand was for larger ditches than could be economically built with floating equipment. The first dragline was built in 1906, and in 1907 a dragline excavator was used on a ditch in Iowa. This machine, crude as it was, gave such large output and low cost of excavation that within a few years the use of this type of excavator had become almost universal.

Efforts to keep irrigated lands productive in the face of alkali accumulation and too high a water table have led to wide use of underdrainage in the west. The practice was developed in this country largely by engineers of those offices of the Department of Agriculture that later became the Bureau of Agricultural Engineering. It is believed the original idea for this improvement in irrigation farming came from early English writers on the subject. Sir William Wilcox, the cele brated English engineer who built the Assua Dam in Egypt, when he was in this countr in 1913, said the methods of draining irri gated lands here were the most importan contribution to irrigation engineering he ha observed.

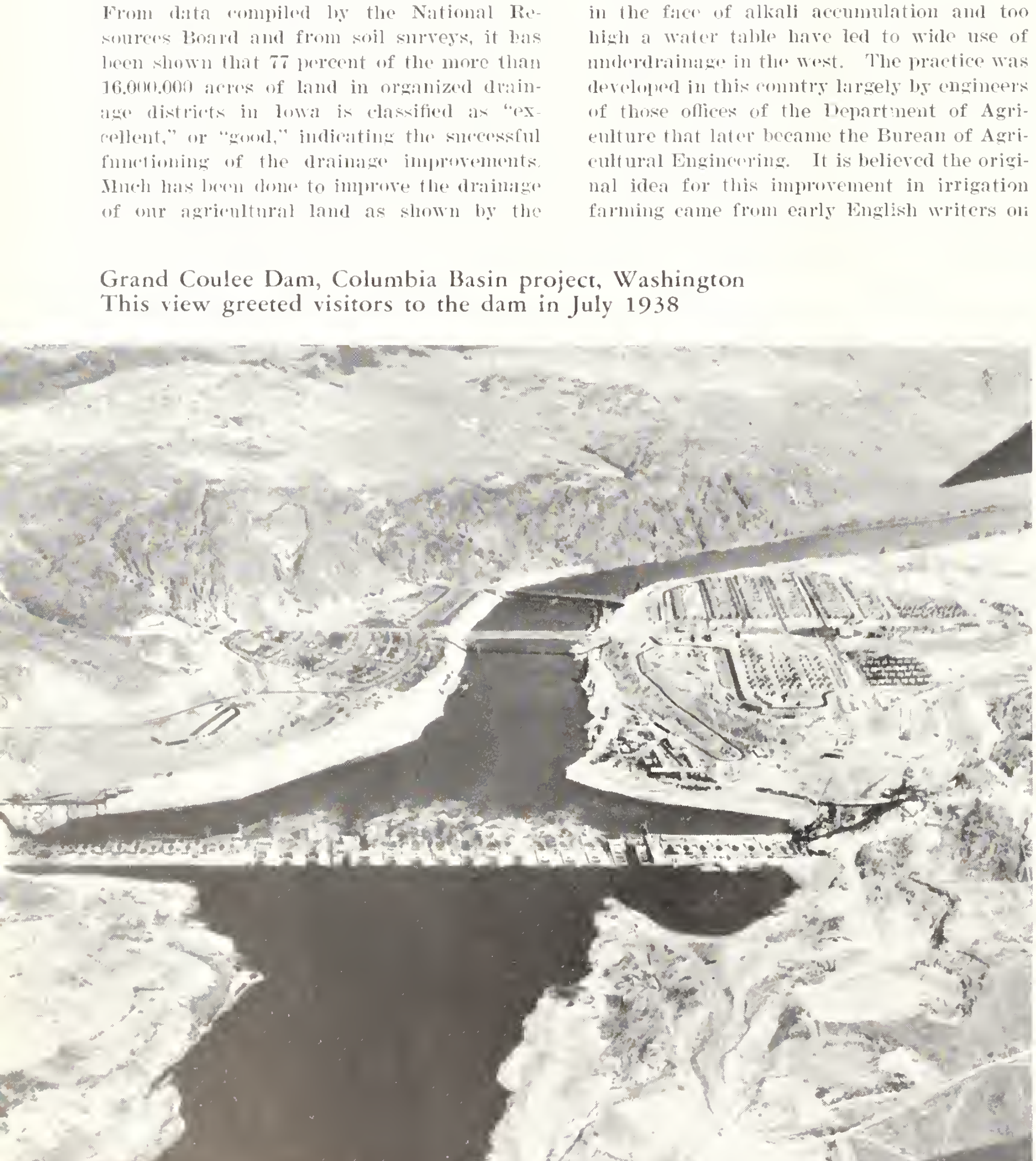
The effect of erosion in lowering the valu of or destroying our agricultural lands ha long been appreciated by students of agri culture. Recently the public has also com to appreciate this. With the creation in 193 of the Soil Conservation Service a major in crease in research on erosion control becam possible. The work done to date has serve to give a clearer conception of the impor tance of erosion, its tremendous effect o agriculture, and the broad measures necessar for its control. The present large researc program will undoubtedly soon make muc clearer the causes of erosion and show ho it can be more efficiently and economicall controlled.

What of the future of these problems o water and the land? As population in th West increases the demand for water will in crease. This will force the development o many supplies now considered too expensiv and will bring about improvements in irriga tion and other water practices with resultan savings that will make the present supply o water go further.

In drainage work, we can confidently loo forward to improvement in design of drainag systems. Greater emphasis will be place upon methods of maintaining drains, bot open and covered, and equipment particularl suited for this work will be developed. A ready much work has been done toward mak ing concrete tile more resistant to alkalie and acids in the soils. Our technique of ero sion control will be further developed an improved, and new types of equipment wi increase efficiency and lower costs.

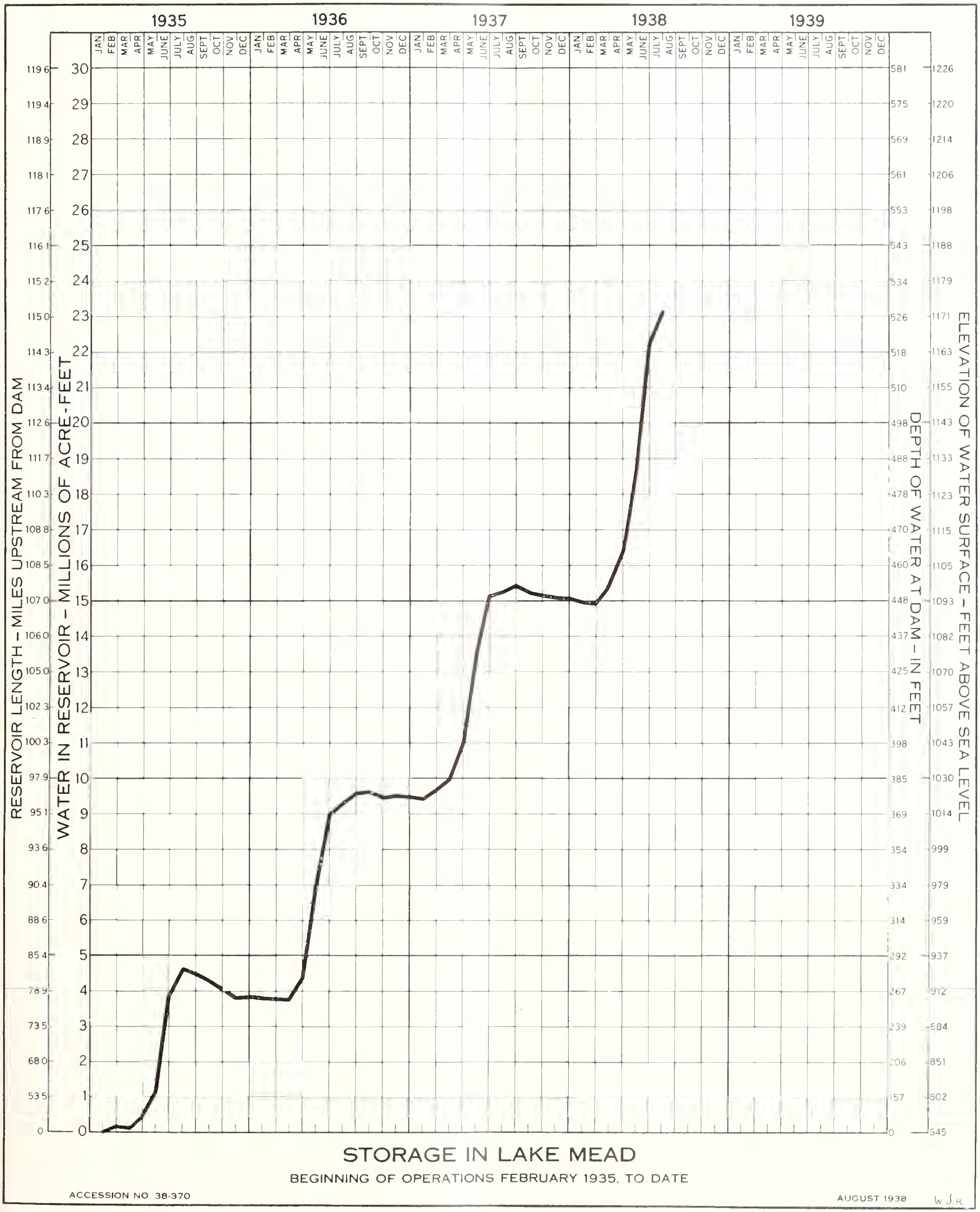
If these things are to come true within reasonable time, research strongly supporte must push forward vigorously for new in formation on which better programs can b built. The problem is many sided and de mands the work of many technically traine men in different scientific fields. Better or ganization is now making it possible for us t get the maximum out of our research effort through cooperation of Federal, State, an other agencies. The teamwork of water an the land is reflected in the teamwork used i solving the water and land problems.

Grand Coulee Dam, Columbia Basin project, Washington
This view greeted visitors to the dam in July 1938



Yakima Reports Favorable Crop Season

WITH the completion of the Yakima Valle cherry and apricot crop harvest, and th shipment of plums, prunes, early apples an potatoes, hay, and truck crops begun, report from the Yakima project indicate a goo quality of crops generally. A satisfactor apple crop also is in prospect.



STORAGE IN LAKE MEAD

BEGINNING OF OPERATIONS FEBRUARY 1935, TO DATE

ACCESSION NO. 38-370

AUGUST 1938

W.J.R.

The Black Canyon of the Gunnison National Monument

THE BLACK CANYON of the Gunnison, located in southwestern Colorado, is one of the outstanding natural scenic attractions of the United States. This canyon is nearly 50 miles in length and can be glimpsed in places along United States Highway No. 50 between Gunnison and Montrose lying hundreds of feet below the road which is located for a distance of several miles high up on the mountain slope above the canyon.

The most picturesque portion of the canyon is now included in the Black Canyon of the Gunnison National Monument which was established during the administration of President Hoover and has been enlarged and made more accessible to the traveling public during the present administration. The monument includes an area of about 13,000 acres and is most conveniently reached by a road 8 miles in length which diverges from United States Highway No. 50 at a point 7 miles east of Montrose. This road winds along a dry arroyo, passes through the irrigated lands of Bostwick Park, and again climbs upward through a forest of juniper, pinion pine, and scrub oak to the rolling lands of the mesa bordering the canyon.

The first view of the canyon is impressive as one emerges from the brush-covered mesa upon the rim of the canyon whose sheer granite walls present themselves with startling suddenness. From this point a wide gravel road maintained in good condition extends along the rim of the canyon.

This gigantic canyon, zigzagged across the rolling surface of the mesa, is most remarkable for the sheerness of its granite walls towering from 1,700 to 2,800 feet above the Gunnison River and in some places presenting sheer vertical drops exceeding 2,000 feet. Numerous short precipitous side canyons enter the main canyon forming high rock points or promontories along the canyon wall. In places these rock points are cut off by deep cross gorges forming what are called the island peaks. The walls in general are of dark color, broken and mottled by light-colored seams of intrusive material. However, many different rock formations are encountered, imparting various colors, of which red is predominant in some locations.

Approach to North Rim

The north rim of the canyon is approached from Highway No. 92, two miles distant from the town of Crawford, or 59 miles from Delta which is the junction point of Highway No. 92 and United States Highway No. 50. Although the canyon may be seen in many places from the road along each rim, much better views, each presenting its own special picture, can be obtained from different points that have been established along the rim of the canyon. On the south side these view points include Pulpit Rock, Spruce Tree Point, Rock Point, Devil's Lookout, Budge Site, and Far View. On the north side are located The Narrows, Eagle's Lookout, Prairie Dog Point, The Island Peak Trail, Wind Point, and Cedar Point. All of these points have trails leading to them from the rim drive and are well located and provided with metal rails which afford a maximum of protection.

There are also a few trails leading to the bottom of the canyon. These, however, are rather steep and difficult for the person who has not had some experience in mountain climbing. Wild Rose Trail, which descends through Echo Canyon, is an old mining trail and is probably the best of these trails to the bottom.

The canyon is justly famous for its echo. At many points the echo of a clear call can be heard several times. Echo Point, located along the trail to Rock Point, is best known. There the echo of even a low call can be heard distinctly once or more at any time and under favorable conditions six or seven echoes of a well-pitched call can be distinguished.

View from Pulpit Rock

An Interesting Museum

The museum, located at present in a small building just below the rim road, contains many interesting relics of the days when this area was an old Indian camp site and hunting ground, including spear and arrow heads, tomahawks, and other implements. It also contains excellent specimens of rock formations characteristic of the area. Mounted flowers and various unique and unusual exhibits are found in the collection.

Rock Point, located just beyond the registration tent on the south side, is one of the most outstanding of the observation points. It is reached by short trail from the rim road—a high rock point with sheer drops to deep canyons below on three sides. To one side lies Echo Canyon, steep in many places but with some less abrupt slopes covered with a heavy growth of fir trees. To the other side, across a lesser canyon, lies Big Island, largest of the island peak formations, with rock walls dropping almost vertically on all sides from its flat brush-covered top.

Straight ahead and more than 2,000 feet below lies the main canyon of the Gunnison. Close observation is required here to pick out from the maze of side canyons and giant

crevices the main canyon through which the river flows.

The bridge site is about the narrowest part of the canyon, with a width from rim to rim of 1,300 feet and a depth at this point of 1,830 feet. Here it is necessary to stand close to the guard railing to see the river, which from this height appears but a small stream winding tortuously between the jagged granite walls of the canyon. Shortly below this point and hidden in the depths of the canyon lies Torrance Falls, invisible from any of the observation points along the rim. Far View Point, where the canyon reaches a depth of 2,800 feet, is at the end of the south rim road about 1 mile below the bridge site. From here may be seen downstream a length of several miles of canyon gradually lessening in the distance.

Wildlife

The flora of the monument area is of wide variety, consisting of types common to both the alpine and subalpine regions. Piñon pine, juniper, and scrub oak, interspersed with chaparral and service bushes, are found in profusion upon the rolling mesa land, which extends to the rim of the canyon on either side, while Douglas fir and aspen are found in the canyon along the bottom and in various locations where slopes are sufficiently flat to support the growth of vegetation. Over 100 varieties of wild flowers have been noted.

On the farther part of the monument area adjacent to the north rim (seldom visited by tourists because this portion is accessible only on foot after a rather arduous hike from the north rim road) is found the heaviest cover of the pinion pine and juniper type with some of the pinion pine attaining a diameter of 30 inches. This area is said to have been a favorite hunting ground of the Indians who would drive deer and bear out of the cover upon some of the promontories formed by side canyons. From these sheer-walled promontories the animals could find no escape except by turning back upon the hunters. The canyon and adjacent area is still a haven for many types of wild animals. Among the most interesting are the mountain sheep which inhabit the precipitous walls of the canyon on both sides, the black-tailed deer which are found along the rims, and the black or brown bear.

To those who can read history in the markings of canyon walls and formations of rock, the canyon tells an interesting story reaching far back into prehistoric times when, through millions of years, the Gunnison River was slowly carving its way from a level at one time probably far higher than the present elevation of the surrounding country. Its history, as most of us understand the term, begins with the development of the West when the area was known as a hunting and camping ground of the Indians. Only about 40 years ago was the attention of the white man seriously attracted to the canyon when the early settlers of the Uncompahgre, faced with shortage of water from the natural run-off of the Uncompahgre River, began to suspect that the Gunnison River, only a few miles distant across the mountains, could be utilized to furnish water to their lands.

Surveys made under very arduous and even dangerous conditions proved that this was the case and eventually resulted in construction of the Gunnison Tunnel, 6 miles in length, which was undertaken in 1905, and now diverts about 1,000 second-feet of water from the Gunnison River to the watershed of the Uncompahgre River. The entrance to this tunnel lies in the canyon about 3 miles above the boundary of the monument.

The National Park Service has established wonderful scenic drives 4 miles in length on each rim of the canyon which are well maintained and safe. Rangers are stationed on both sides to be of service to the visitors and to protect the monument for the use of the public. Registration is required at the entrance to both rims and regulations governing the monument are at the registration book which will help the rangers in protecting the area and serve as a guide to visitors.

Since the beginning of 1938 much work has been done to improve this national monument. Sowing of grass seed has been undertaken to establish a ground cover for the few barren areas that border the road, the museum has been established, parking areas have been provided, and trails have been constructed to the scenic areas. Camping or picnic grounds are maintained near the end of the road on both sides of the canyon.

Progress of Investigations of Projects

THE following is a brief summary of the work during the month of July 1938:

Arizona-California, Colorado River Valley surveys.—Preparation was continued of the map from the mosaics and aerial photographs of the Colorado River from Boulder Dam to Topoc and from Parker to the Mexican boundary and along the lower Gila River.

California, Kings River-Pine Flat project.—Field operations were begun at the end of the month for investigation of the project.

Colorado, Blue River transmountain diversion.—Water-supply studies continued, including studies of the Ute Park reservoir site on Williams River, and design of dam at Stronia site.

Colorado, eastern slope surveys.—Reports of the Hugo and Chivington projects about completed and flood-control studies of Trinidad project in progress.

Colorado, western slope surveys.—Water-supply studies were continued and designs in course of preparation for irrigation structures on the Collbran, Florida, LaPlata, and Paonia projects.

Idaho, Cabinet Gorge project.—Studies were made of regulation of Flathead Lake and designs of Cabinet Gorge Dam about completed.

Southwest Idaho.—Studies were continued of storage dams at the Cascade and Cabarton sites and water-supply studies of Payette and Salmon River Basins.

Snake River storage.—Drilling was in progress at Elk Creek Dam site and design of dam at The Narrows site prepared and storage data of Jackson Lake compiled.

Montana, Marias project.—Survey of canal and tunnel lines continued and land classification of 92,000 acres completed.

Nebraska, Bostwick project.—Report of the project was approved.

Oklahoma, Fort Supply and Kenton projects.—Land classification of the Fort Supply project area was continued for 20,000 acres and Kenton project report was completed.

Oregon, Canby, Grande Ronde, and Medford projects.—Reports were nearly completed of the Canby and Grande Ronde projects and report of the Medford project begun.

Utah, Gooseberry project.—Water-supply studies of Gooseberry and Scofield Reservoirs continued and surveys of canal and tunnel lines about completed.

Utah-Idaho-Wyoming, Bear River surveys.—Surveys in connection with aerial map of the Bear River Valley were continued, and a reconnaissance of the valley below Bear Lake made. Surveys were made of several reservoir sites.

Colorado River Basin.—Land classification was continued of areas in Colorado and Utah, surveys of canal lines in the Green River Basin in Wyoming were continued, and geological survey of 18 dam sites made, and a reconnaissance was made of the San Juan River Basin in Colorado and New Mexico.

Yuma Grapefruit

THE new crop of grapefruit on the Yuma auxiliary project is developing in fine shape, with indications of a larger crop than in previous years.

Civilian Conservation Corps Accomplishments on Federal Reclamation Projects

FISCAL YEAR 1938

By ALFRED R. GOLZÉ, *Supervising Engineer, CCC*

DURING the 1938 fiscal year the 34 CCC camps allocated to the Bureau of Reclamation carried forward an extensive conservation program based on permanently improving the Federal reclamation projects.

Rehabilitation of the canal systems and accessory structures continued as the outstanding feature of the CCC program, with the provision of supplemental water supplies and recreational developments at irrigation reservoirs also constituting important CCC activities. Auxiliary to these principal CCC work features were improvements to wildlife refuges at reservoirs, rodent control operations, and weed eradication experiments.

Operating through the fiscal year for a total of 923,000 man-days, the CCC enrollees on reclamation projects were engaged chiefly in moving 1,165,600 cubic yards of earth and 40,300 cubic yards of rock, placing 161,200 square yards of concrete lining, building 3,000 water-control structures, constructing 590 miles of operating roads, building 82 vehicle bridges, principally over canals, cleaning and clearing 7,463,300 square yards of canals, laying 92,600 feet of pipe and tile lines, riprapping 234,700 square yards of canal banks, and moving 382,800 cubic yards in leveling spoil banks.

A few of the more important physical features in progress during the 1938 fiscal year involved in these statistics include completion of the reconstruction of the lower embankment of the Deer Flat Reservoir on the Boise Federal reclamation project, in western Idaho. This embankment, in reality, an earth dam 6,800 feet in length, has been blanketed by CCC enrollees with hand-placed rock riprap on the upstream face, surmounted by a masonry parapet wall. This protection work permanently eliminates the former erosion of this dam by wind and wave action, which, prior to the commencement of CCC work, was seriously threatening the life of the structure.

Another outstanding project is on the Rio Grande Federal reclamation project in southern New Mexico, where the Box Canyon Dam was 98 percent complete at the end of the fiscal year. CCC forces are building this large masonry structure 50 feet high and 220 feet in length to control the serious flash floods occurring during the summer season, destroying Government canals crossing the mouth of the canyon below.

Completed during the summer of 1937 was the clearing of the Clear Creek Reservoir, an irrigation water storage unit of the Yakima Federal reclamation project in central Washington. CCC forces have been at work removing dead timber from this reservoir, located high in the Cascade Mountains, during the summers of 1935, 1936, and 1937. The completion of this work insures trouble-free operation of the Government dam and outlet works connected with this reservoir, as well as removal of an eyesore from one of the outstanding scenic regions of the United States. Control of the famous Yellowstone River as it passes through the Huntley Federal reclamation project, east of Billings in southern Montana, was advanced with the construction of additional jetties forcing the river currents into the center of the stream channel and eliminating erosion of valuable farm lands immediately adjacent to the river.

Following the unprecedented floods in June 1937, on the Pecos River in southern New Mexico, CCC enrollees undertook the reconstruction of the old McMillian Dam, damaged by the flood, and improvements to the spillways of the Avalon Dam. This work, completed in April 1938, has placed the storage facilities of the Carlsbad reclamation project in excellent physical condition.

CCC work at Coulee Dam, Wash., was completed in June. For a period of approximately 2½ years the enrollees had been at work landscaping and providing tourist and recreational facilities in this Government city

CCC enrollees reconstructing McMillan Dam, Carlsbad project

at the site of Grand Coulee Dam. The attractive appearance of the town is not only impressive to the occasional visitor but has made it a better and more comfortable place to live for the hundreds of Government employees assigned to this immense project located in the semiarid section of central Washington.

During the past winter CCC forces on the Newlands Federal reclamation project in western Nevada cleaned and repaired the spillway surfaces at the Lahonton Dam. This work was particularly important, as the reservoir overflowed in the spring of 1938 for only the third time since it was placed in operation in 1915. As emergency work, CCC enrollees from reclamation camps, augmented with enrollees loaned by the Division of Grazing, reconstructed the Malone diversion dam on the Klamath Federal reclamation project in southern Oregon. This dam was partially destroyed during a high flood early in December 1937, and its restoration to service by June of 1938 was essential to insure uninterrupted irrigation of the farm area adjacent to the dam. Through the fine work of the CCC boys this objective was achieved.

Supplemental Water Supplies Developed by CCC Labor

CCC men have developed supplemental water supplies for reclamation projects through the construction of small reservoirs and the building of feeder canals, bringing additional water to existing reservoirs. In Utah the past fiscal year witnessed completion, except for the parapet and curb wall, of the Midview Dam, located near Bridgeland, in the eastern part of the State. The 5,000 acre-foot reservoir created by this dam is filled twice a year to supply additional water to the Moon Lake Federal reclamation project. On the Huntley Federal reclamation project in southern Montana, the Anita Dam, an earth structure 1,000 feet in length and 40 feet in height, was completed and placed in operation to conserve the flow of water and provide supplemental storage for the eastern portion of this project. On the Newlands reclamation project in Nevada, the "S-Canal" regulating reservoir with a capacity of 1,500 acre-feet was completed by CCC enrollees during the fiscal year. This reservoir provides a means of regulating the "S-Canal" system, conserving valuable irrigation water that would otherwise be wasted. In connection with the Moon Lake project in Utah the CCC has begun construction on the 17-mile Yellowstone feeder canal, designed to supplement and insure an adequate supply of water for this Federal project.

Recreational Developments

Recreational developments continued through the 1938 fiscal year; the principal activities of this nature being concentrated at the Elephant Butte Reservoir in New Mexico, at Lake Walcott in Idaho, and at Guernsey Lake in Wyoming. These developments provide an opportunity for recreation to communities surrounded by desert and remotely situated from the developed areas of the national parks and national forests. At the Elephant Butte development, construction by the CCC men of the concession building was 98 percent complete at the close of the fiscal year and the structure was in partial use. Trailer parking facilities, public picnic grounds, floating piers, and swimming facilities have all been completed at this reservoir, and are daily used by a large number of people from the nearby Rio Grande Federal reclamation project. Improvements of grounds and construction of picnic facilities were the chief accomplishments at the Lake Walcott Park on the Minidoka Federal reclamation project in Idaho. At Guernsey Lake, in Wyoming, the final touches were made in a recreational development begun in 1934 under the supervision of the National Park Service. This latter park, with its large picnic grounds, road system around the lake, and fine museum, is an outstanding recreational center in this section of the country. Similar creative developments were commenced below the Lahonton Dam in the Newlands Federal reclamation project in Nevada, and at the Pineview Dam in the beautiful Ogden Canyon in Utah. Plans have been in progress and construction is expected to begin in the 1939 fiscal year on recreational developments at Alamogordo Reservoir in southeastern New Mexico, and the Alcova Reservoir in central Wyoming; both new irrigation storage units recently completed for the Bureau of Reclamation.

In several instances, CCC enrollees are jointly cooperating with regular Government forces in the construction of new irrigation projects. On November 1, 1937, the President approved the finding of feasibility for the Deschutes reclamation project in central Oregon, approving the use of CCC men to aid in the reclaiming of 50,000 acres of dry farm lands for diversified irrigation agriculture. The Director, CCC, on June 18, authorized the establishment of the necessary CCC camps. At the end of the fiscal year, one CCC company had been located on the project, and two more arrived in July, to place under actual construction this valuable asset to our Western conservation achievements.

Wildlife Refuges

Cooperating with the Bureau of Biological Survey, CCC men are developing wildlife refuges at the Deer Flat Reservoir in western Idaho, at the Tulelake wildlife refuge in northern California, just south of the Oregon State line, at Lake Walcott, in southern Idaho, and at the Pishkun Reservoir in Montana. At the Elephant Butte Reservoir, CCC

Irrigation flume constructed by CCC, Truckee River storage project

forces are constructing a 14-pond fish hatchery, which, on completion, will be operated by the Bureau of Fisheries under a memorandum of agreement signed by the Secretary of the Interior and the Secretary of Commerce. At the end of the fiscal year 5 of the 14 ponds, with 140,000 bass, were in actual use. The fish from this hatchery will be used to stock the Elephant Butte Reservoir, the Rio Grande, and the larger canals of the Rio Grande reclamation project, providing fishing facilities heretofore not enjoyed by the residents of this area. In many localities reclamation camps located near the national forests were called upon to assist in the control and suppression of numerous small forest fires, although the 1937 fiscal year witnessed fewer demands on reclamation camps for forest fire fighting assistance than the previous year.

Pest Eradication

Control of rodents, principally the pocket gopher and the ground squirrel, was continued throughout the fiscal year, 540,000 acres on Government projects having been treated. The menace of noxious weeds has been constantly increasing on the reclamation projects. The canal system affords excellent transportation of seeds to all parts of the irrigated land, and the problem of eradication and control is a complex as well as a serious one. CCC forces do not enter on private lands to eradicate weeds, but the farmers are shown, by demonstration on Government tracts, the methods of attacking the different types of weeds. Sample demonstrations are also conducted on the Government canals for the benefit of the operating personnel, and experiments with different types of grasses that will crowd out weeds on canal banks and perhaps afford a pasture crop as well, are in progress on many projects.

During the year increasing attention has been given to the job-training aspects of the CCC operations. The work on reclamation projects involving, for example, the building of concrete and masonry water-control structures, the mechanical moving of large quantities of earth, and the construction of simple roads, with related phases of the construction work, all afford a wonderful opportunity for the eager-to-learn boy to acquire training of great value to him when he leaves the corps. Through a practical arrangement of training on the job, followed by classroom work after hours, combined with a system of outlines and reports which were inaugurated during the fiscal year, the entire project training program has rapidly advanced, benefiting not only the individual enrollee but also the work projects through increased efficiency.

The safety feature of the CCC work programs was repeatedly emphasized throughout the year with gratifying results; the number of lost-time accidents being materially less than for the previous year. The reduction in accidents, coupled with increased efficiency on the work projects, has developed a fine organization with a high morale, which is an integral unit of the Bureau of Reclamation in the conduct of its widespread conservation activities.

Trailer camp built by CCC forces, Elephant Butte Reservoir

Reclamation Camps Lead CCC in Safety in 1937

DATA recently released by the Safety Engineer, in the Office of the Director, CCC, show that, as a group, the 34 CCC camps allocated to the Bureau of Reclamation for the 1937 calendar year had the best safety record of all classes of CCC camps, as evidenced by their low frequency rate of 19.54 lost-time accidents per million man-hours of exposure.

This rate compares with an average frequency rate of 29.90 for the CCC camps as a whole. It reflects great merit on the CCC field personnel of the Bureau that in only their second full year of operation on reclamation projects, the reclamation camps are in the forefront of the CCC safety parade. This is particularly commendable, as the majority of the CCC programs involve construction work with its usual attendant hazards to the workman.

Visitors to Boulder

DURING the month of July 65,690 persons, traveling in 21,091 cars, were checked through the two checking stations operated on the Boulder Canyon project by the National Park Service. Those entering the Nevada gate numbered 43,387 in 14,024 cars, and 22,303 persons in 7,067 cars entered the Arizona gates. There were 365 visitors to the Overton district, and 278 visited the Pierce Ferry area. During the period 20,996 persons in 6,319 cars passed through the Lake Mead checking station.

Ninety-two planes carrying 441 passengers, 6 special trains with 1,400 passengers, and 2,245 persons in 208 busses also entered the area during the month.

Persons making the trip to the powerhouse via the elevators numbered 39,637, of which 32,224 were paid admissions; 6,446 were children under 16 years of age, and 967 persons, mostly employees, were not charged.

Orland Crop Yields

THE condition of field crops at the close of July on the Orland project, California, was excellent. Alfalfa fields yielded well and, where not abused by overgrazing, ladino clover pastures continued to afford feed for the project's many dairy herds. Several owners of ladino pastures harvested seed crops and good seed yields are reported.

Reclamation Fulfills Its Mission

COMMISSIONER JOHN C. PAGE, Commissioner of Reclamation, writing in the magazine RECLAMATION ERA, tells why he believes "Reclamation Fulfills Its Mission." No one reading his text can very well disagree with him.

Since President Teddy Roosevelt signed the Reclamation act on June 17, 1902, 34 irrigation projects have been constructed to serve more than 3 million acres of arid desert land. Fifty thousand irrigated farms and 257 towns and cities have sprung up to serve the 900,000 people who have found their homes on irrigation projects. They have built communities which support 859 public schools and 996 churches. Their banks at the close of the last year had a total of deposits of more than 225 millions of dollars.

Those figures alone, we believe, speak worlds for the effectiveness of the Bureau Mr. Page has served so long and which he now directs.

While Imperial Valley is not rightly a Reclamation Bureau project, it would not be amiss to say it owes a great part of its existence to the Bureau. Construction of the All-American Canal, now nearing completion, is owed entirely to this agency. To the valley the Reclamation Bureau is a sort of beloved step-parent, revered for its accomplishments and honored for its unquestioned integrity.

Reclamation, whether directed by the Bureau or merely under a protecting wing, has paid out. It has made America a greater agricultural and industrial continent. It has furnished homes and happiness to thousands who might otherwise be struggling along the fringes of prosperity on worn-out farms.—*Imperial Valley Press, El Centro, Calif., July 26.*

A Church in Paradise Valley

PARADISE VALLEY, a section of the Riverton project opened to settlement in 1931 and so called by homesteaders from the parched, dry lands of Nebraska, dedicated a substantial log church of the Presbyterian denomination in the spring of 1938. The new building, which is 28 by 40 feet, is made of logs hewn on two sides and sealed with oakum. The land for the structure was donated by Rush Brown, a homesteader, and the men of Paradise Valley helped complete the building.

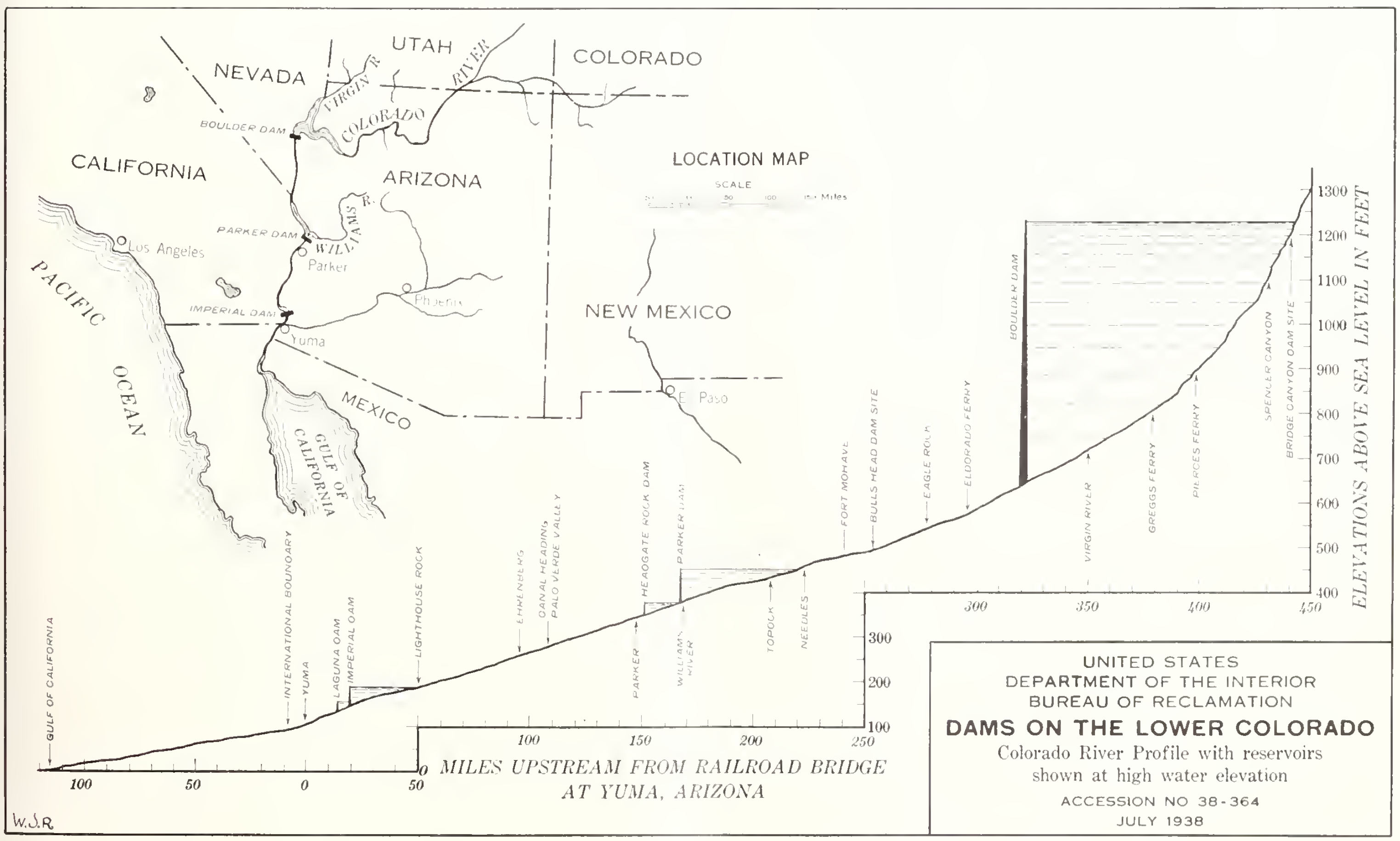
The Sunday school, called Good Hope for a friend who made the first contribution toward its support, was the first religious group to be organized in Paradise Valley. This was in the fall of 1933 when settlers desired religious education for their children. Meetings were then held in different homes. From the original 10 members it grew steadily as the valley was settled to its present membership of 100. So fine a record of attendance was made by the school that it drew the attention of the Board of National Missions of the Presbyterian Church, which donated $1,000 toward the church building with the understanding that an additional $500 be raised.

The church in connection with the Sunday school, organized October 7, 1937, by members of the Casper Presbytery, is called the Union Presbyterian Church. It now has a membership of 40 and a regular attendance of 65 each Sunday. The never-flagging efforts of Mrs. Lyda C. Wood, missionary, are greatly responsible for the wonderful results accomplished in Paradise Valley. She has had charge of the work since the beginning and now preaches the first Sunday of each month.

GOLDIE L. BEZOLD.

Truckee Storage Livestock

REPORTS indicate that this will be an exceptionally good livestock year on the Truckee storage project, Nevada. This is especially due to the excellent range feed. Dairy stock also are in good condition.



List of Principal Labor Contracts

State	Project	Description of work	Contractor	Amount of contract	Work started	Probable date of completion	Percent complete July
Arizona	Gila	Construction of Gila River crossing	Metropolitan Construction Co., Los Angeles, Calif.	$337,376	Feb. 1938	Jan. 1940	31
Do	Salt River	Construction of Bartlett Dam	Barrett & Hilp and Macco Corp., Clearwater, Calif.	2,236,224	Aug. 1936	Apr. 1939	79
Arizona-California	All-American Canal	Concrete drops and powerhouse structure.	Pleasant-Hassler Construction Co., Phoenix, Ariz.	675,390	June 1937	Mar. 1939	58
Do	do	Concrete drops and powerhouse structures.	Frank J. Kernan & John Klug Co., South Portland, Oreg.	398,934	do	do	56
Do	do	Earthwork, canal lining, and structures.	Southwest Welding & Manufacturing Co., Alhambra, Calif.	111,504	Dec. 1937	Feb. 1939	80
Do	Parker Dam	Construction of Parker Dam and appurtenant works.	Six Companies, Inc., San Francisco, Calif.	5,622,000	Sept. 1934		91
Arizona-Nevada	Boulder Canyon	Furnishing and installing generators	General Electric Co., Schenectady, N. Y.	1,346,090	Apr. 1937		85
California	Central Valley	Diversion tunnel and temporary relocation of S. P. R. R. at Shasta Dam.	Colonial Construction Co., Spokane, Wash.	426,475	July 1938	Feb. 1939	3
Colorado	Pine River	Construction of Vallecito Dam	Martin Wunderlich Co., Jefferson City, Mo.	2,115,870	May 1938	Sept. 1942	6
Idaho	Boise-Payette	Earthwork and structures, Black Canyon, A Line and D Line Canals.	Haas, Doughty & Jones and Marshall & Stacy, San Francisco, Calif.	172,687	June 1938	Aug. 1939	1
Idaho-Wyoming	Upper Snake River storage.	Construction of Island Park Dam	Max J. Kuney Co., Spokane, Wash.	613,746	Oct. 1935		88
Do	do	Construction of Grassy Lake Dam	S. J. Groves & Sons Co., Minneapolis, Minn.	488,478	June 1937	Sept. 1938	22
Montana	Milk River	Construction of Fresno Dam	Wachter, O'Neil & McGarry Bros., Bismarck, N. Dak.	1,117,409	Mar. 1937	Feb. 1940	42
Nevada-California	Truckee storage	Construction of Boca Dam	George W. Condon, Omaha, Nebr.	738,405	Apr. 1937	July 1939	22
Texas	Colorado River	Construction of Marshall Ford Dam	Brown & Root Co., Inc., Austin, Tex.; McKenzie Construction Co., San Antonio, Tex.	5,823,585	Feb. 1937	do	62
Utah	Provo River	Construction of Deer Creek Dam and appurtenant works.	Rohl-Connolly Co., Los Angeles, Calif.	2,189,096	July 1938	Mar. 1942	4
Do	Sanpete	Construction of Spring City Tunnel	Dan Teters & Co., Inc., Riverside, Calif.	128,235	Nov. 1937	Feb. 1940	64
Washington	Columbia Basin	Completion of Grand Coulee Dam	Consolidated Builders, Inc., Oakland, Calif.	34,442,240	Mar. 1938	Feb. 1942	2
Do	Yakima-Roza	Earthwork, canal lining, and structures.	Guthrie, McDougall Co., Portland, Oreg.; Mark C. Walker & Son Co., Omaha, Nebr.	487,237	Nov. 1937	Dec. 1938	81
Do	do	Earthwork, tunnel, and canal lining	T. E. Connolly Co., Los Angeles, Calif.	316,142	May 1938	Apr. 1939	9
Wyoming	Kendrick	Construction of Seminoe Dam and power plant.	Winston Bros. Co., Minneapolis, Minn.; Morrison-Knudsen Co., Boise, Idaho; Utah Construction Co., Ogden, Utah.	3,000,657	Jan. 1936		68
Do	Shoshone-Heart Mountain.	Earthwork, canal lining, and structures.	James Crick, Spokane, Wash.	224,553	Sept. 1937		74
Do	do	do	Northwestern Engineering Co., Rapid City, S. Dak.	173,604	Apr. 1938	Mar. 1939	45
			Total, 23 contracts	63,185,937			

NOTES FOR CONTRACTORS

Specifications No.	Project	Bids opened	Work or material	Low bidder		Bid	Terms	Contract awarded
				Name	Address			
		1938						1938
1086-D	Buffalo Rapids, Mont.	June 28	2,300-volt motor control equipment transformers, lightning arrester, air-break switch, expulsion fuses.	The Wolfe & Mann Mfg. Co.	Baltimore, Md.	[1] $3,447.00		July 22
				The Standard Transformer Co.	Warren, Ohio	[2] 16,849.80	F. o. b. Fallon, Mont.	July 25
				General Electric Co.	Schenectady, N. Y.	[3] 343.20	do	July 23
				Johnson Mfg. Co.	Atlanta, Ga.	[4] 490.95	do	July 29
				Pacific Electric Mfg. Co.	Chicago, Ill.	[5] 346.00	do	Aug. 1
1096-D	Yakima, Wash.	July 20	Radio telephone apparatus	Communication Equipment & Eng. Co.	do	2,194.00		July 28
1082-D	Columbia Basin, Wash.	June 29	Construction of roads to the Rock Island Dam.	Goodfellow Bros. Inc.	Wenatchee, Wash.	15,642.50		Aug. 5
1094-D	Owyhee, Oreg.-Idaho	July 18	Construction of Owyhee ditch pumping plaut and discharge pipe.	Vernon Bros. Co.	Boise, Idaho	26,748.00		Aug. 9
20,754-T	Kendrick, Wyo.; Riverton, Wyo.; Colorado-Big Thompson, Colo.	July 27	Insulators	Ohio Brass Co.	Mansfield, Ohio	47,779.00	F. o. b. Barberton, Ohio.	Aug. 9
789	Columbia Basin, Wash.	July 1	40 102-inch diameter welded plate steel conduit linings, etc., for outlet works, Grand Coulee Dam.	Puget Sound Machinery Depot.	Seattle, Wash.	208,585.00		Aug. 20
1100-D	Riverton, Wyo.	Aug. 1	3 34,500-volt power transformers	Kuhlman Electric Co.	Bay City, Mich.	[1] 6,333.00	F. o. b. Riverton, Wyo.	Aug. 10
			8 air-break switches	Graybar Electric Co.	Denver, Colo.	[2] 1,520.00	do	Aug. 11
			8 lightning arresters	do	do	[3] 840.00	do	Aug. 11
1081-D	Boulder Canyon, Ariz.-Nev.	June 6	Schedule 2, Water-jet eductors	Schutte & Koerting Co.	Philadelphia, Pa.	9,650.00	F. o. b. Philadelphia, Pa.	Aug. 3
			Schedule 3, Air relief valves	Urguhart Service	Denver, Colo.	162.90	F. o. b. Berwick, Pa.	Aug. 3
			Schedule 4, Check valves	Crane-O'Fallon Co.	do	2,387.00	F. o. b. Jeannette, Pa.	Aug. 4
1106-D	Colorado-Big Thompson, Colorado.	Aug. 8	Preparation of concrete aggregates	All bids rejected				
A-38,106-B.	Columbia Basin, Wash.	July 28	Copper in rolls, 12 inches wide, 140,000 pounds.	Goldberg Bros.	Denver, Colo.	18,942.00	F. o. b. Odair, Wash.	Aug. 20
B-42,101-A.	All-American Caual	Aug. 4	Steel reinforcing bars	Bethlehem Steel Co.	San Francisco, Calif.	14,027.82	F. o. b. Calexico, Calif.	Aug. 24
B-42,099-A.	do	Aug. 2	do	Columbia Steel Co.	Denver, Colo.	42,060.00	do	Aug. 20
Proj. No. 766	Boise-Payette	Aug. 3	Preparing and stock piliug sand aud gravel	J. A. Tertcliug & Sons	Boise, Idaho	10,470.00		Aug. 22

[1] Item 1. [2] Item 2. [3] Item 3. [4] Item 4. [5] Item 5.

L. H. Mitchell Addresses Federal Irrigation Congress

L. H. MITCHELL, field supervisor of the Operation and Maintenance Division, delivered an address at the annual meeting of the Federal Irrigation Congress at Torrington, Wyo., on September 1. His address, Practical Use of Soil and Water, was illustrated by colored slides which are described in this issue. Coming to Torrington direct from 4 months' field work in northern and central projects, Mr. Mitchell spoke from first-hand experience and observation on improved irrigation practices. Mr. Mitchell emphasized particularly the importance of giving careful thought to more beneficial use of soil and water.

Summarizing the important points illustrated by the slides Mr. Mitchell urged irrigators to: (1) Get acquainted with what is below the ground surface on the farm; (2) level the ground if it is rough, providing, of course, the soil is not already close to sand or hardpan; (3) plan farming operations so the soil will be improved by adding humus, green or barnyard manures, and, if needed, commercial fertilizers; (4) use a small plot to experiment with different fertilizers and different quantities of water; (5) plan a system of spreading water that will allow the proper irrigation of plants as quickly as possible, due consideration being given to reducing waste of water; (6) know the root habits of plants and keep the root zone in a moist (not too wet or dry) condition from seeding time until the plant is mature or shortly before harvest; (7) use a moisture prober to find out where water has penetrated and to prevent over or underirrigating; and (8) keep in mind that soil is a reservoir holding water for plant roots from one irrigation to another and that guessing when it is empty, partly filled, or running over is likely to result in greatly reducing crop yields.

Slides on Irrigating Now Available for Loan

SUCCESSFUL FARMING on an irrigation project requires that irrigators give continuous study and thought to improving their farming and irrigation practices.

To acquaint irrigators with new and improved methods in irrigation farming, the Bureau of Reclamation has prepared a series of slides, in color, entitled "Practical Use of Soil and Water."

These slides present in picture and graphic form recent information on soil and water management. Interesting soil profiles explain the importance of knowing farm soil conditions, including the layers below the plow slice. Scenes from Federal reclamation projects depict present-day practices to improve soil structure and fertility and to prevent loss of fertility through leaching and erosion. How to prepare land for irrigating and new labor-saving equipment for this work are shown. The importance of choosing the proper irrigation system is emphasized and two systems, the corrugation and border methods, are presented. Also included in the study of more efficient irrigation methods are the new ridge or bed system of sugar-beet culture and the plan for 18-inch and 26-inch row spacings in bean culture. Attention is particularly directed to the root habits of plants and the application of water to the root zone. Charts, based on experiments over a 5-year period at the Scottsbluff Field Station, Nebr., give the soil depths from which water is taken by different crops grown under irrigation. How to find out where water has penetrated when irrigating and how to keep in close touch with moisture conditions throughout the growing season are shown through the use of a simple tool known as a moisture prober.

The slides are available without cost, except for the payment of express charges, to irrigation superintendents, county agents, schools, agricultural groups, and civic organizations. Requests for the loan of the slides should include information as to the dates they are desired and where they will be shown and may be addressed to the Commissioner, Bureau of Reclamation, Washington, D. C.

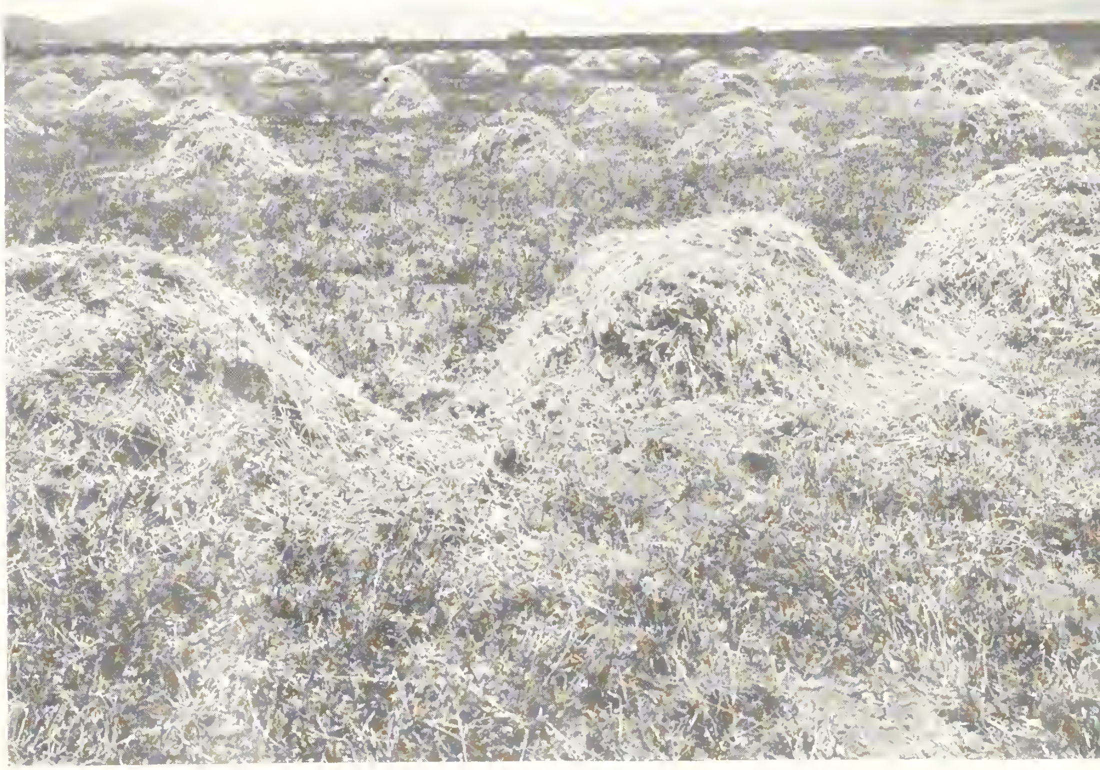
Sheep Growers Association Belle Fourche Project

THE Western South Dakota Sheep Growers Associated was organized at Belle Fourche, S. Dak., July 2 by about 150 sheepmen of that section. The purpose of the group is to control disease and to promote the sheep industry.

Klamath Crops

ALL CROPS on the Klamath project, Oregon-California, made an excellent growth during July, and better than average yields are anticipated. The project potato area is estimated at 20,000 acres, with a possible yield as great as 10,000 carloads. The alsike clover seed area is estimated to exceed 3,000 acres, or more than 2.5 times greater than the past year. All small seed crops are in excellent condition, and heavy yields are looked for.

An alfalfa field on the Owyhee project, Oregon-Idaho



Reclamation Organization Activities

Commissioner Page Returns

JOHN C. PAGE, Commissioner of Reclamation, returned to Washington September 8, after a 6 weeks' tour of the Northwestern projects. On a portion of the trip Mr. Page was accompanied by Chief Engineer R. F. Walter.

Personnel Changes

THE following recent personnel changes in the Bureau of Reclamation have been authorized by the Secretary of the Interior:

Appointments

Washington Office:

William Ernest Hicklin, audit clerk, from National Park Service.

James M. Myles, Jr., engineering aide, CCC division.

Mrs. Catherine C. Johnson, senior stenographer, Chief Clerk's division, by transfer from Denver Office.

Denver Office:

Harold W. Finch, assistant engineer, formerly in War Department, St. Louis, Mo.

Courtney T. Judah, associate engineer, by transfer from Department of Agriculture.

Fred H. Marsh, associate engineer, formerly in War Department, U. S. Engineer's Office.

Central Valley project:

Texas B. Gibson, junior photographer.

Edward L. Edmundson, assistant attorney detailed to Office of the Solicitor.

Transfers

To Denver:

Richard T. Larsen, associate engineer, from Salt River project, Phoenix, Ariz.

Robert A. Goodpasture, junior engineer, from Fort Collins.

James W. Ball, assistant engineer, from Fort Collins.

William O. Parker, model maker, from Fort Collins.

Harold L. Davis, assistant engineer, from Salt River project, Phoenix, Ariz.

To Columbia Basin project:

Carl J. Nielsen, associate engineer, from assistant engineer, Denver office.

To Central Valley:

Wilbur A. Dexheimer, engineer, from Salt River project, Phoenix, Ariz., to Shasta Dam.

Walter E. Seyfarth, associate engineer, from Friant division, Friant, Calif., to the Sacramento office.

To Colorado-Big Thompson, Green Mountain Dam:

Samuel F. Crecelius, construction engineer from Caballo Dam, Caballo, N. Mex.

To Colorado-Big Thompson, Granby division

John R. Iakisch, construction engineer, from Kings River, Pine Flat investigations, Fresno, Calif.

To Deschutes project:

Charles LeMoyne, Jr., junior engineer, from Owyhee project, Boise, Idaho.

Samuel A. McWilliams, engineer, from Parker Dam.

Change in Designation

Central Valley project:

Walker R. Young, from construction engineer to supervising engineer.

Wedding

MISS ELEANOR MILLS, registration clerk in the mails and files division of the Washington Office, was married on August 27 to George Petticord, a young architect.

Mrs. Petticord has presented her resignation to become effective September 11. The young couple will make their future home in Pittsburgh, Pennsylvania.

Officials of the Northern Colorado Conservancy District sign contract between the United States Bureau of Reclamation and the conservancy district for construction of the Colorado-Big Thompson project, which will bring waters of tributaries of the Colorado River from the Grand Lake-Granby District to northern Colorado farms of the eastern slope

Left to right, standing: Fred Norcross, Greeley; Burgis Coy, engineer, Fort Collins; R. G. Wright, Sterling; R. C. Benson, Loveland; William A. Carlson, Greeley; Ralph McMurray, Fort Collins; Ray Lanyon, Longmont; Ed F. Munroe, Fort Collins; Moses Smith, Ault; W. E. Letford, Longmont; and C. M. Rolfson, Julesburg. Seated: Thomas A. Nixon, attorney; Charles Hansen, president of the district, signing the document; and J. M. Dille, of Fort Morgan, secretary and manager of the district

Courtesy The Greeley Daily Tribune

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ADMINISTRATIVE ORGANIZATION OF THE BUREAU OF RECLAMATION

HAROLD L. ICKES, SECRETARY OF THE INTERIOR

E. K. BURLEW, FIRST ASSISTANT SECRETARY and Budget Officer (in charge of reclamation)

John C. Page, Commissioner — Roy B. Williams, Assistant Commissioner

J. Kennard Cheadle, Chief Counsel and Assistant to Commissioner; Miss Mae A. Schnurr, Chief, Division of Public Relations; George O. Sanford, General Supervisor of Operation and Maintenance; D. S. Stuver, Asst. Gen. Supr ; Wesley R. Nelson, Chief, Engineering Division; P. I. Taylor, Assistant Chief; A. R. Golzé, Supervising Engineer, C. C. C. Division; W. E. Warne, Director of Information; William F. Kubach, Chief Accountant; Charles N. McCulloch, Chief Clerk; Jesse W. Myer, Chief, Mails and Files Division; Miss Mary E Gallagher, Secretary to the Commissioner

Denver, Colo., United States Customhouse

R. F. Walter, Chief Eng.; S. O. Harper, Asst. Chief Eng.; J L. Savage, Chief Designing Eng.; W H. Nalder, Asst. Chief Designing Eng.; L. N. McClellan, Chief Electrical Eng.; Kenneth B. Keener, Senior Engineer, Dams; H R. McBirney, Senior Engineer, Canals; E. B Debler, Hydraulic Eng.; I. E. Houk, Senior Engineer, Technical Studies; Spencer L. Baird, District Counsel; L. R. Smith, Chief Clerk; Vern H. Thompson, Purchasing Agent; C. A. Lyman and Henry W. Johnson, Examiners of Accounts; L. S. Davis, Engineer, C. C. C. Division

Projects under construction or operated in whole or in part by the Bureau of Reclamation

Project	Office	Official in charge		Chief clerk	District counsel	
		Name	Title		Name	Address
All-American Canal [1]	Yuma, Ariz.	Leo J. Foster	Constr. engr	J. C. Thrailkill	R. J. Coffey	Los Angeles, Calif.
Belle Fourche	Newell, S Dak	F. C. Youngblutt	Superintendent	J. P. Siebeneicher	W. J. Burke	Billings, Mont.
Boise	Boise, Idaho	R. J. Newell	Constr. engr	Robert B. Smith	B. E. Stoutemyer	Portland, Oreg.
Boulder Dam and power plant [1]	Boulder City, Nev	Irving C. Harris	Director of Power	Gail H. Baird	R J. Coffey	Los Angeles, Calif.
Buffalo Rapids	Glendive, Mont	Paul A. Jones	Constr engr	Edwin M. Bean	W. J. Burke	Billings, Mont.
Carlsbad	Carlsbad, N. Mex	L. E. Foster	Superintendent	E. W. Shepard	H. J. S Devries	El Paso, Tex.
Central Valley	Sacramento, Calif	W. R. Young	Supervising engr	E. R. Mills	R. J. Coffey	Los Angeles, Calif.
Colorado-Big Thompson	Denver, Colo			C. M. Voyen	J. R. Alexander	Salt Lake City, Utah.
Colorado River	Austin, Tex	Ernest A. Moritz	Constr. engr	William F. Sha	H. J. S. Devries	El Paso, Tex.
Columbia Basin	Coulee Dam, Wash.	F. A. Banks	Constr. engr	C. B. Funk	B. E. Stoutemyer	Portland, Oreg.
Deschutes	Bend, Oreg	C. C. Fisher	Engineer	Jame A Dolphin	B. E. Stoutemyer	Portland, Oreg.
Fruit Grower's Dam	Montrose, Colo		Constr. engr	Ewalt P. Anderson	J. R. Alexander	Salt Lake City, Utah.
Gila	Yuma, Ariz.	Leo J. Foster	Constr. engr	J. C. Thrailkill	R J. Coffey	Los Angeles, Calif.
Grand Valley	Grand Junction, Colo	W. J. Chiesman	Superintendent	Emil T. Ficenec	J. R. Alexander	Salt Lake City, Utah.
Humboldt	Lovelock, Nev	Stanley R. Marean	Superintendent	George B. Snow	J. R. Alexander	Salt Lake City, Utah.
Kendrick	Casper, Wyo	H. W. Bashore	Constr. engr	George W. Lyle	W J. Burke	Billings, Mont.
Klamath	Klamath Falls, Oreg	B. E. Hayden	Superintendent	W. I. Tingley	B. E. Stoutemyer	Portland, Oreg.
Milk River	Malta, Mont	H. H. Johnson	Superintendent	E. E. Chabot	W J. Burke	Billings, Mont.
Fresno Dam	Havre, Mont	H V. Hubbell	Constr engr	E. E. Chabot	W. J. Burke	Billings, Mont.
Minidoka	Burley, Idaho	Dana Templin	Superintendent	G. C. Patterson	B. E. Stoutemyer	Portland, Oreg.
Moon Lake	Duchesne, Utah	E. J. Westerhouse	Constr. engr	Francis J. Farrell	J. R Alexander	Salt Lake City, Utah.
North Platte	Guernsey, Wyo	C. F. Gleason	Supt. of power	A. T. Stimpfig	W. J. Burke	Billings, Mont.
Orland	Orland, Calif	D. L. Carmody	Superintendent	W. D. Funk	R. J. Coffey	Los Angeles, Calif.
Owyhee	Boise, Idaho	R. J. Newell	Constr. engr	Robert B. Smith	B E. Stoutemyer	Portland, Oreg.
Parker Dam	Parker Dam, Calif	Howard P. Bunger	Constr engr		R. J. Coffey	Los Angeles, Calif
Pine River	Bayfield, Colo	Charles A. Burns	Constr. engr	Frank E. Gawn	J. R. Alexander	Salt Lake City, Utah.
Provo River	Provo, Utah	E. O Larson	Constr. engr	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
Rio Grande	El Paso, Tex	L. R. Fiock	Superintendent.	H. H. Berryhill	H. J. S. Devries	El Paso, Tex.
Caballo Dam	Caballo, N. Mex	S. F. Crecelius	Constr. engr	H H. Berryhill	H. J. S Devries	El Paso, Tex.
Riverton	Riverton, Wyo	H. D. Comstock	Superintendent	C. B. Wentzel	W. J. Burke	Billings, Mont.
Bull Lake Dam	Riverton, Wyo		Resident engr	C. B. Wentzel	W. J. Burke	Billings, Mont.
Salt River	Phoenix, Ariz	E. C. Koppen	Constr. engr	Edgar A. Peek	R. J. Coffey	Los Angeles, Calif.
Sanpete	Provo, Utah	E. O. Larson	Constr. engr	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
Shoshone	Powell, Wyo	L. J. Windle	Superintendent [2]	L. J. Windle [2]	W J Burke	Billings, Mont.
Heart Mountain division	Cody, Wyo	Walter F. Kemp	Constr. engr	L. J. Windle [2]	W. J. Burke	Billings, Mont.
Sun River, Greenfields division	Fairfield, Mont	A. W. Walker	Superintendent		W J. Burke	Billings, Mont.
Truckee River Storage	Reno, Nev	Charles S. Hale	Constr. engr	George B. Snow	J. R. Alexander	Salt Lake City, Utah.
Umatilla (McKay Dam)	Pendleton, Oreg	C. L. Tice	Reservoir supt		B. E. Stoutemyer	Portland, Oreg
Uncompahgre: Repairs to canals	Montrose, Colo	Denton J. Paul	Constr engr [2]	Ewalt P. Anderson	J. R. Alexander	Salt Lake City, Utah.
Upper Snake River Storage [3]	Ashton, Idaho	H A. Parker	Constr. engr	Emmanuel V. Hillius	B. E Stoutemyer	Portland, Oreg.
Vale	Vale, Oreg	C. C. Ketchum	Superintendent		B. E. Stoutemyer	Portland, Oreg.
Yakima	Yakima, Wash	J. S. Moore	Superintendent	Philo M. Wheeler	B. E. Stoutemyer	Portland, Oreg.
Roza division	Yakima, Wash	Charles E. Crownover	Constr. engr	Alex S. Harker	B. E. Stoutemyer	Portland, Oreg.
Yuma	Yuma, Ariz	C. B. Elliott	Superintendent	Noble O. Anderson	R. J. Coffey	Los Angeles, Calif.

[1] Boulder Canyon. [2] Acting. [3] Island Park and Grassy Lake Dams.

Projects or divisions of projects of Bureau of Reclamation operated by water users

Project	Organization	Office	Operating official		Secretary	
			Name	Title	Name	Address
Baker (Thief Valley division) [1]	Lower Powder River irrigation district	Baker, Oreg	A. J. Ritter	President	F. A. Phillips	Keating.
Bitter Root [4]	Bitter Root irrigation district	Hamilton, Mont	N. W. Blindauer	Manager	Elsie H. Wagner	Hamilton.
Boise [1]	Board of Control	Boise, Idaho	Wm. H. Tuller	Project manager	L. P. Jensen	Boise.
Boise [1]	Black Canyon irrigation district	Notus, Idaho	W. H. Jordan	Superintendent	L. M. Watson	Caldwell.
Frenchtown	Frenchtown irrigation district	Frenchtown, Mont	Edward Donlan	President	Ralph P. Schaffer	Huson.
Grand Valley, Orchard Mesa [3]	Orchard Mesa irrigation district	Grand Jctn., Colo	C. W. Tharp	Superintendent	C. J. McCormich	Grand Jctn.
Huntley [4]	Huntley irrigation district	Ballantine, Mont	E. E. Lewis	Manager	H. S. Elliott	Ballantine.
Hyrum [3]	South Cache W U. A.	Wellsville, Utah	B. L. Mendenhall	Superintendent	Harry C. Parker	Logan.
Klamath, Langell Valley [1]	Langell Valley irrigation district	Bonanza, Oreg	Chas. A. Revell	Manager	Chas. A. Revell	Bonanza.
Klamath, Horsefly [1]	Horsefly irrigation district	Bonanza, Oreg	Henry Schmor, Jr.	President	Dorothy Eyers	Bonanza.
Lower Yellowstone [4]	Board of Control	Sidney, Mont	Axel Persson	Manager	Axel Persson	Sidney.
Milk River: Chinook division [4]	Alfalfa Valley irrigation district	Chinook, Mont	A. L. Benton	Vice President	R. H. Clarkson	Chinook.
Minidoka: Gravity [1]	Minidoka irrigation district	Rupert, Idaho	Frank A. Ballard	Manager	O. W. Paul	Rupert.
Pumping [1]	Burley irrigation district	Burley, Idaho	Hugh L. Crawford	Manager	Frank O Redfield	Burley.
Gooding [1]	Amer. Falls Reserv. Dist. No. 2	Gooding, Idaho	S. T. Baer	Manager	Ida M. Johnson	Gooding.
Newlands [3]	Truckee-Carson irrigation district	Fallon, Nev	W. H. Wallace	Manager	H. W. Emery	Fallon.
North Platte: Interstate division [4]	Pathfinder irrigation district	Mitchell, Nebr	T. W. Parry	Manager	Flora K. Schroeder	Mitchell.
Fort Laramie division [4]	Gering-Fort Laramie irrigation district	Gering, Nebr	W. O Fleenor	Superintendent	C. G. Klingman	Gering.
Fort Laramie division [4]	Goshen irrigation district	Torrington, Wyo	Floyd M. Roush	Superintendent	Mary E. Harrach	Torrington.
Northport division [4]	Northport irrigation district	Northport, Nebr	Mark Iddings	Manager	Mabel J. Thompson	Bridgeport.
Ogden River	Ogden River W. U. A.	Ogden, Utah	David A. Scott	Superintendent	Wm. P. Stephens	Ogden, Utah.
Okanogan [1]	Okanogan irrigation district	Okanogan, Wash	Nelson D. Thorp	Manager	Nelson D. Thorp	Okanogan.
Salt Lake Basin (Echo Res.) [3]	Weber River Water Users' Assn	Ogden Utah	D. D. Harris	Manager	D. D. Harris	Layton.
Salt River [2]	Salt River Valley W. U. A.	Phoenix, Ariz	H. J. Lawson	Superintendent	F. C. Henshaw	Phoenix.
Shoshone: Garland division [4]	Shoshone irrigation district	Powell, Wyo	Paul Nelson	Acting irri supt.	R. J. Schwendiman	Powell.
Frannie division [4]	Deaver irrigation district	Deaver, Wyo	Floyd Lucas	Manager	Harry Barrows	Deaver.
Strawberry Valley [3]	Strawberry Water Users' Assn	Payson, Utah	S. W. Grotegut	President	E. G. Breeze	Payson.
Sun River: Fort Shaw division [4]	Fort Shaw irrigation district	Fort Shaw, Mont.	C. L. Bailey	Manager	C. L. Bailey	Fort Shaw.
Greenfields division [4]	Greenfields irrigation district	Fairfield, Mont	A. W. Walker	Manager	H. P. Wangen	Fairfield.
Umatilla: East division [1]	Hermiston irrigation district	Hermiston, Oreg	E. D. Martin	Manager	Enos D. Martin	Hermiston.
West division [1]	West Extension irrigation district	Irrigon, Oreg	A. C. Houghton	Manager	A. C. Houghton	Irrigon.
Uncompahgre [3]	Uncompahgre Valley W. U. A	Montrose, Colo	Jesse R. Thompson	Manager	H. D. Galloway	Montrose.
Yakima, Kittitas division [1]	Kittitas reclamation district	Ellensburg, Wash	V. W. Russell	Manager	G. L. Sterling	Ellensburg.

[1] B. E. Stoutemyer, district counsel, Portland, Oreg.
[2] R. J. Coffey, district counsel, Los Angeles, Calif.
[3] J. R. Alexander, district counsel, Salt Lake City, Utah.
[4] W. J. Burke, district counsel, Billings, Mont.

Important investigations in progress

Project	Office	In charge of—	Title
Colorado River Basin, sec. 15	Denver, Colo	E. B. Debler and P. J. Preston	Senior engineer.
Boise-Weiser-Payette	Boise, Idaho	Lester C. Walker	Engineer.
Cabinet Gorge	Clarks Fork, Idaho	Wm. G. Sloan	Engineer.
Kenton and Fort Supply	Denver, Colo	A N. Thompson	Engineer.
Black Hills	Denver, Colo	Denver Office	
Eastern Slope (Colo.)	Denver, Colo	A. N. Thompson	Engineer.
Salt Lake Basin	Provo, Utah	E. O. Larson	Construction engineer.
Marias	Shelby, Mont	Fred H. Nichols	Associate engineer.
Bear River Surveys	Salt Lake City, Utah	E G. Nielsen	Associate engineer.

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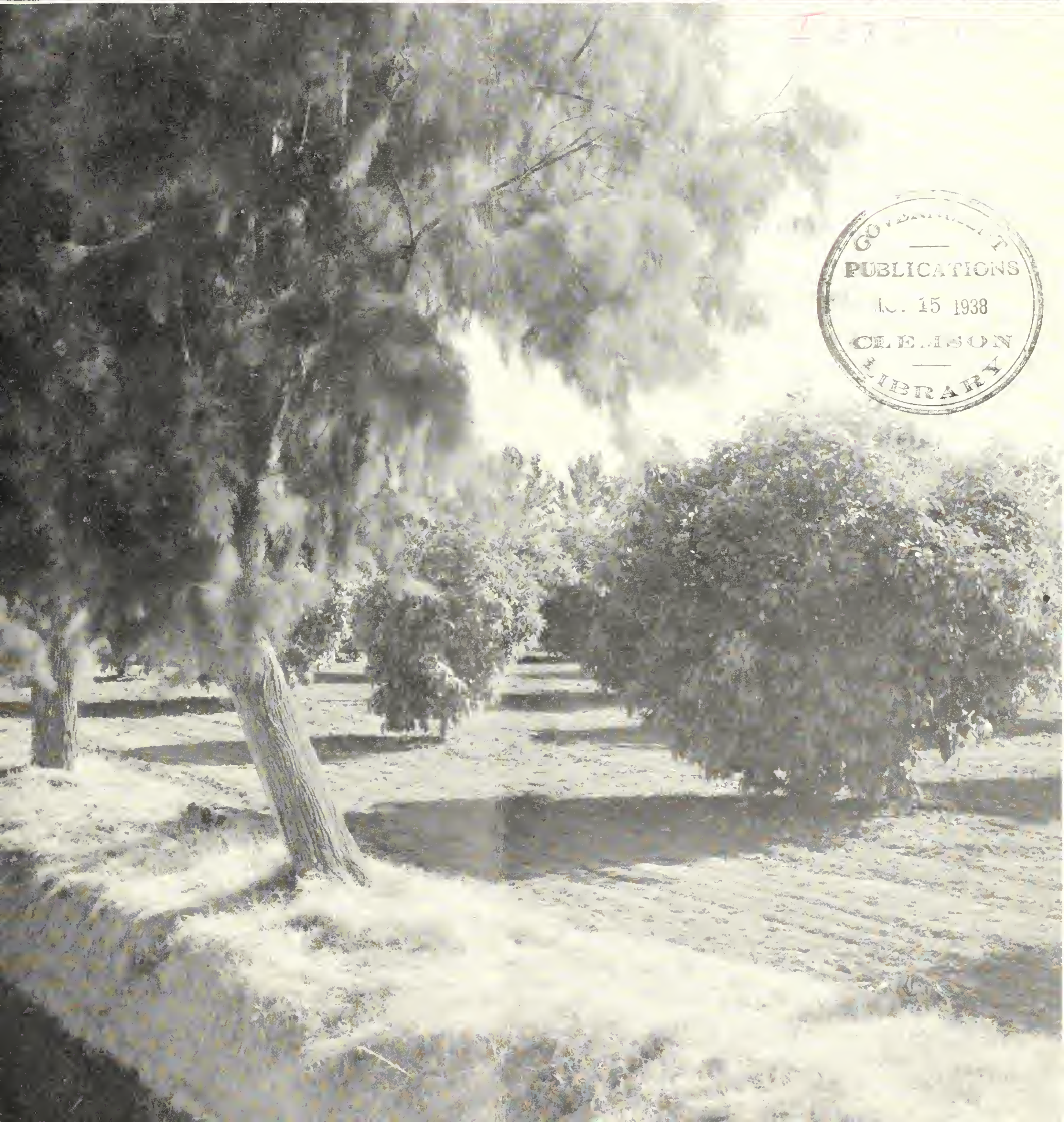
SOUTHWESTERN IRRIGATION PROJECTS MEET WINTER DEMAND FOR LETTUCE

THE RECLAMATION ERA

OCTOBER 1938



Reclamation Fund

ON October 6, a Treasury warrant was issued crediting the Reclamation Fund with $29,778,210.23, as settlement under the Hayden-O'Mahoney amendment to the 1939 Interior Department Appropriation Act, representing 52½ percent of accumulated naval oil royalties covering the period February 25, 1920, to June 30, 1938, inclusive. This credit permitted the retiring of a $15,000,000 loan made to the Reclamation Fund several years ago.

The naval oil royalties is a new source of income to the Reclamation Fund and will take the place of diminishing revenues from the sale of public lands and oil royalties, the latter due to a policy of restricted operations as a conservation measure.

As continued operation under the Reclamation Law is again financed by authorization of appropriations from the Reclamation Fund, in contrast to appropriation of emergency money from general funds of the Treasury, this new source of income to the Reclamation Fund was particularly timely. After paying off the loan, the balance is available for the Bureau's construction program and added to that will be the normal income to the fund, plus the return of emergency moneys appropriated or allotted to the Bureau for its operations during the past several years and covered by repayment contracts. This money would ordinarily have been returned to the General Treasury, but under special authorization in the same Interior Department Appropriation Act, accruals to the Reclamation Fund will develop as soon as payments are commenced under repayment and power contracts made on projects so financed.

JOHN C. PAGE, *Commissioner.*

PRICE ONE DOLLAR A YEAR

THE RECLAMATION ERA

VOLUME 28 • OCTOBER 1938 • NUMBER 10

CONQUERING CLIMATE

By Hon. HAROLD L. ICKES, *Secretary of the Interior*[1]

ONE of the celebrated quips of Mark Twain, who once lived in an historic camp near Reno, was that everyone talks about the weather but no one ever does anything about it.

Here in the West so very much has been done through the conservation, storage, and control of water, and through irrigation to mitigate the effect of an arid climate that Mark Twain's wisecrack is no longer quite in point. We are doing something about it: we are conquering an arid climate. Of course this was not the case in the time of the great humorist, back beyond the day when Reno became, as you say, the "Biggest Little City in the World." Then, the metal veins had not yet begun to pinch out, and probably no one even thought that it would become necessary to find another and more permanent base, through irrigation, for this western civilization.

Even during more recent times, now happily on their way out, many in other sections that are blessed by nature with a humid climate, did not understand the need for irrigation. They looked upon it as an expensive boondoggle, unwillingly financed by eastern taxpayers, by means of which a farmer in the West managed to wangle out of Mother Nature a larger yield than natural laws intended that he should have. There was no clear and general understanding of the conditions that made irrigation essential to habitation of much of this region, which constitutes one-third of all the United States. There was little sympathy with the titanic efforts to make the West livable; to make it a contributor to the wealth of the country; a sturdy block in our up-building Nation. With a clearer understanding of the national benefits of irrigation, that time has all but gone.

In recent years there has welled up in this country a great interest in conservation problems generally. This has resulted from the fact that under the influence of our dynamic leader, President Franklin D. Roosevelt—a great conservationist opposed to the improper exploitation of our resources, whether human or material—we, as a people, have adopted a more sensible course. The United States now is determined to use profitably but prudently what is left of its generous endowment and to conserve it for the benefit of future generations in order that our children's children may also live, with decent standards, in a great Nation.

Eastern States are considering the problems of the West more charitably; the flood control problem of the Mississippi Valley is viewed more sympathetically by those remote from the danger of overflow; the impoverished soils of the South are receiving attention as are the polluted streams of the East; an intelligent law for the conservation and protection of our vast grazing lands has been adopted, and is operating in a generally satisfactory manner; great dams to control erratic western rivers are being constructed in order that the agricultural lands of this section may be expanded through irrigation; and the Federal Government no longer has a blind eye turned toward the tremendous possibilities for public betterment that lie in the development of hydroelectric power, where feasible, in connection with its great public works.

Interior—Conservation Department

Conservation is a word that is glibly and sometimes loosely used. The best definition I know is that conservation is the prudent use of those gifts of nature upon which we rely for support, comfort, and spiritual solace. In practice it means making every natural resource serve mankind while preserving all that is possible for the needs of future generations.

The Department of the Interior, through its many responsibilities in connection with public lands, the Indians, the national parks, forestry, reclamation, oil, mining, the work of the Geological Survey, and grazing, touches intimately the lives of many people, and in the West of most of the people. States like Nevada, Arizona, and New Mexico, for example, find most of their territory and interests closely identified with the operations of the Department of the Interior. This places upon the Secretary of the Interior an especially responsible duty to this vast and important section of our country.

From the outset this duty has been heavy upon me. As a conservationist, I have been called upon to weigh the problems of the country as a whole against local or sectional considerations; I have kept before me constantly the thought that true conservation recognizes the prudent use of our endow-

Itinerary of the Secretary's Trip From Reno

SECRETARY ICKES left Reno by auto on October 14 arriving the same day in Boulder City, where he addressed the assembled supervisory personnel of the Bureau of Reclamation called by Commissioner Page for a conference on Bureau affairs. Driving from Boulder City through Coachella and Imperial Valleys the Secretary stopped en route to inspect the Metropolitan Water District aqueduct tunnel near Palm Springs and at Brawley where he started a generator in a PWA power plant erected at that point.

After a drive along the route of the All-American Canal to Imperial Dam on October 18 the Secretary took part in the ceremony and made a talk in connection with the dedication of Imperial Dam and turning of the first water into the All-American Canal.

On up through California by auto the Secretary will arrive at Redding on October 22 to take part in the exercises in connection with the beginning of work on Shasta Dam, which is now under construction in the Sacramento River Canyon 12 miles to the north.

The Secretary's next stop will be at Bonneville Dam and, after a short visit, he will drive on to Grand Coulee Dam for an inspection of the work there, leaving Spokane October 26 for the East.

[1] Address delivered October 13, 1938, at the banquet of the Seventh Annual Convention of the National Reclamation Association, held at Reno, Nev.

tem by the present generation as well as the rights of future generations.

Most of the conservation activities of the Federal Government, no matter by what Department they now are administered, had their origin in the Department of the Interior.

Conservation has become the major task, as it is the chief preoccupation, of this Department. Let us hope that it always will remain so. It is important to the Nation and especially to the West that it should.

Prudent Use of Water

Some who term themselves conservationists refuse to consider the reclamation of arid lands as a conservation enterprise and thereby attempt to exclude water from among our resources. Yet water is a fundamental and the most valuable resource of this region. A conservation program which foolishly excluded it would not be a conservation program at all. Water is not like metals and oil, since it is not an exhaustible resource. It is replenished at its source by nature from year to year. But water can be wasted, and in some instances it has been used unwisely. Its prudent use is perhaps more important to the everyday life of this arid and semiarid region than any other single phase of our conservation program. The conservation of water must continue, and it must be guided intelligently.

There is one danger with respect to our water resources, however, which should not be overlooked. There is one pitfall which must be avoided. In our progress from selfish exploitation to conservation through prudent use we must not overrun the point at which the general welfare best is served. Special groups must not be permitted to capitalize on the new attitude and gain for themselves undue advantages. A proper balance must be struck and maintained. The responsibility for and the cost of the improvements made in the name of conservation should not be shifted entirely to the Federal Government. Local communities, States, and regions must continue to do their part.

Here, at this meeting, you are interested primarily in irrigation and the reclamation of desert lands. A great senator from this State of Nevada, the late Francis G. Newlands, was largely responsible for arousing the West to the importance of irrigation and for its adoption as a Federal policy. Since 1902 the Department of the Interior has been entrusted with carrying forward the Federal Reclamation program. I submit that it has proved itself to be worthy of that trust; so much so that it should have the exclusive duty of carrying on our reclamation program.

Loans to Reclamation Repayable

The theory and the fact have been that the cost of Federal Reclamation projects, through collections from the irrigators and other water users, is repaid to the United States over a period of years. Of about $250,000,000 expended on projects now in operation, approximately $50,000,000 thus far have been returned to the United States Treasury. Allotments from the relief funds made to the Bureau of Reclamation for construction of projects—like the money appropriated directly by the Congress—are covered in full by repayment contracts. There is no other comparable Federal program with such a record. The people of the West should take pride in these facts. The people of the North, South, and East, likewise, should take pride in such a record.

Federal Reclamation has resulted to date in providing water for 3,000,000 acres of land that formerly was so dry as not to be usable. On this irrigated land, 51,834 farms and 254 towns, with a combined population of almost 900,000 persons, have been created. When completed, projects now under construction will add another 2,500,000 acres to the lands irrigated in the West. On this new land another 800,000 or more persons eventually will live. The providing of opportunities to make successful homes for this number of people is a magnificent achievement. It is one to which the Government and the Department of the Interior can point with justifiable satisfaction.

In recent months, many proposals for new reclamation developments have come before me. Every one of these, before the project is undertaken, is checked carefully by the very competent engineering staff of the Bureau of Reclamation. At times, however, I have been subjected to pressure exerted to induce me to override the findings of the Bureau. This happens only when somebody's pet proposal has been found to be not entirely feasible and when it has been determined that the project could not pay out in full. These advocates have insisted that allowances should be made here and that special consideration should be given there.

If the Department permitted the considered and impartial findings of its engineers to be heedlessly overridden, the West would be storing up trouble for itself. Every project, so conceived, would be destined to become a skeleton in the closet of reclamation. It might not have been the baby of the Bureau of Reclamation, but it would be an in-law of that patriarch. When such a project died, as it surely would, it would have to be buried in the Bureau's family plot. There it could not rest in peace. Its bones would be rattled by every prejudiced orator who could gain an unguarded ear.

One mistake, when made by an agency of the Federal Government, quickly develops a voice which drowns out the pipings of a dozen successes. A dog is permitted one bite, but a Federal officer is given no allowance of errors. Probably this is as it should be, but it places a tremendous burden upon those of us who are in charge of such programs as that of reclamation. We must tread warely. We must do our level best to see to it that projects which are undertaken are good projects with a reasonable chance for success in their mission of creating opportunities for people to make homes and decent livings.

Members of the National Reclamation Association, citizens of Reno, and the people of the West can help us by building up public opinion against selfish promotional efforts in behalf of questionable projects; by helping us to weigh proposals against the general welfare and not against local or temporary gains; and by supporting the policy that a repayment contract remain a valid obligation for the repayment of the cost of the project and not become a depreciating note.

Some critics of Federal Reclamation have charged that the contract for repayment by the water users of the cost of the project which made their homes possible, soon becomes a political plaything. They draw pictures of candidates competing for office like relay runners, passing these contracts from one to the other like batons, striving to get first to the point were the contracts will be abandoned completely. This, of course, is not true. Relief has been granted, when conditions warranted it, just as it has been granted in other circumstances of distress. After all, ours is not a government of oppression of the people living in reclamation areas or of discrimination. When adversity comes upon settlers of reclamation projects their government should not demand its pound of flesh any more than in other similar cases.

Vigilance must be maintained, however, to prevent the development of such a condition as the critics would like to find. That is my responsibility. It is also the responsibility of Commissioner Page whose stature as an able and devoted public servant is already clearly recognized. But it is no less the responsibility of all of you who, living in the West, believe that the future of the arid regions depends, to a large degree upon the future of the Federal Reclamation policy.

Reclamation Alert to Opportunities

The Bureau of Reclamation no sooner finishes one breath-taking project than it moves on to greater victories. It might have rested on its laurels when, in record time, it made the turbulent Colorado River submit to curb bit. Yet before the people could become used to the majesty and grandeur of Boulder Dam we undertook the largest reclamation construction program in our history. This includes such amazing projects as the Grand Coulee Dam on the Columbia River in Washington and the Central Valley project in California, both of them magnificent in their scope and courageous in their design. When completed, these, in the order

(Continued on page 206)

Boulder Dam and Boulder City Post Construction Period

By SIMS ELY, *Project City Manager*

DURING the period of active construction of Boulder Dam from the spring of 1931 to the winter of 1934–35, the number of visitors was steadily increasing. This continuous increase and the evidently eager interest with which everybody viewed the spectacle were understood to be largely due to the public desire to witness a great outdoor show of an unusual sort—and to the satisfaction and thrill which everybody got from looking at that animated panorama, including, as it did, the most spectacular construction methods the world had known—many of these methods being wholly new, and all on a more superlative scale than any dam had previously presented. There was little talking among the crowds. They stood silently and looked, and many of them stayed for hours.

The people who came in those construction years saw operations which were thrilling to all beholders. In the graphic words of Commissioner Page:

"No major construction work of a more hazardous nature than that at Boulder Dam ever has been undertaken. Built in a rock walled canyon, both narrow and very deep, Boulder Dam subjected the men who worked on it to risks which were many times magnified by its rugged setting. Men were dangled at the ends of ropes a thousand feet above the river, scaling off the loose rock. Here were driven four tremendous tunnels at the very bottom of the gorge where tropic heat and the magnitude of the operations increased the dangers ordinarily attached to blasting, and lining such bores. The muckers, the pipe fitters, the carpenters, the steel erectors, the concrete and cleanup crews worked elbow to elbow in close confinement on the rising piers of the dam while overhead more than 3 million yards of concrete were moving in buckets suspended by steel strands. Truck drivers wound their heavy equipment up construction roads with which, by comparison, the highway to the top of Pike's Peak was a bridle path. Sections of steel pipe, 30 feet in diameter and weighing more than 150 tons, were swung down by cables hauled through narrow apertures in the cliffs to be fitted together in the tunnels within."

Added to all this could be seen as a part of the hourly routine, the apparently perilous transportation of workers through the air from one canyon wall to the other, a fifth of a mile above the river bed, by means of cables

Tourists swarm to Boulder Dam

from which were suspended open-top boxes (called "Joe McGees"), the sides of which were some 3 feet high, these boxes at times swaying to and fro in a wide arc—a strictly modern showing of "the daring young man on the flying trapeze." To be seen, also, at every change of shift, was the quick transportation of workers on an inclined railroad called a "monkey slide," running from a terrace on the Nevada cliffs to the dam, hundreds of feet below; and, also, the almost instant travel by nearly vertical "monkey slides" on both the upper and lower faces of the dam.

All this spectacle, wholly novel to practically every visitor, was sufficient certainly to account for the increasing crowds of spectators who came month after month.

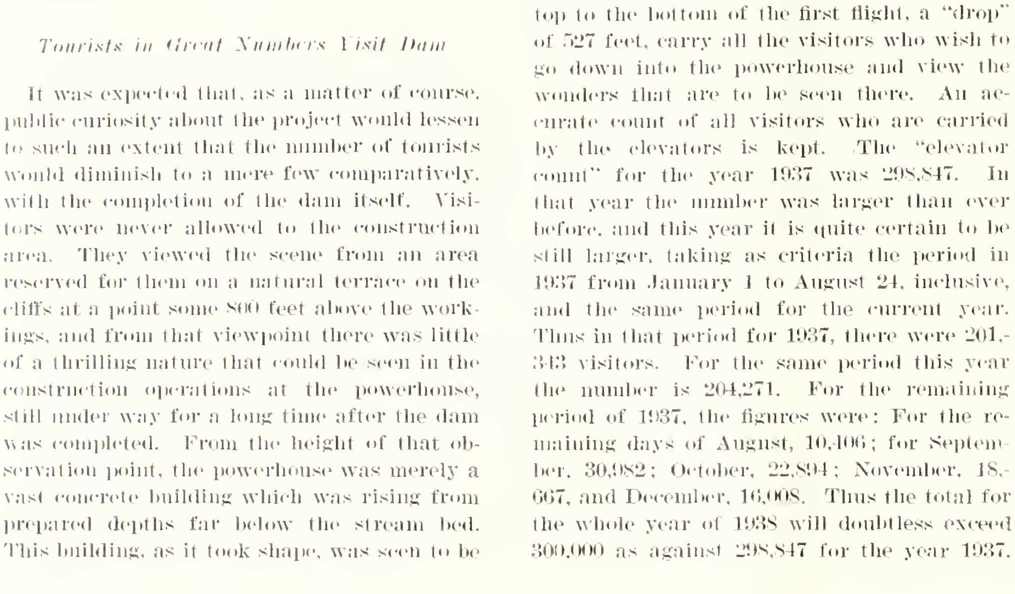
But why did this flood of visitors continue, and steadily increase, after the active exhibition was over?

Tourists in Great Numbers Visit Dam

It was expected that, as a matter of course, public curiosity about the project would lessen to such an extent that the number of tourists would diminish to a mere few comparatively, with the completion of the dam itself. Visitors were never allowed to the construction area. They viewed the scene from an area reserved for them on a natural terrace on the cliffs at a point some 800 feet above the workings, and from that viewpoint there was little of a thrilling nature that could be seen in the construction operations at the powerhouse, still under way for a long time after the dam was completed. From the height of that observation point, the powerhouse was merely a vast concrete building which was rising from prepared depths far below the stream bed. This building, as it took shape, was seen to be an eighth of a mile long, and filling the entire width of the canyon, the building shaped like a giant capital letter U with the rounded portion of the U forming an integral part of the mass of concrete which rested against the toe of the dam. Viewed from above, where the visitors had to stay, these later construction activities were too far away to be thrilling to anybody, and anyhow it was just an enormous concrete building getting itself constructed, with the workers looking so small that they were comparable to insects. This building was all stupendous, to be sure, and built to house the largest aggregation of electrical machinery ever assembled.

Yet the crowds came, and continued to come, in larger numbers each year. Why? The reason will be given presently. First, let us look at some statistics of the latest travel. Elevators built into the heart of the dam, and operating from the highway surface at the top to the bottom of the first flight, a "drop" of 527 feet, carry all the visitors who wish to go down into the powerhouse and view the wonders that are to be seen there. An accurate count of all visitors who are carried by the elevators is kept. The "elevator count" for the year 1937 was 298,847. In that year the number was larger than ever before, and this year it is quite certain to be still larger, taking as criteria the period in 1937 from January 1 to August 24, inclusive, and the same period for the current year. Thus in that period for 1937, there were 201,343 visitors. For the same period this year the number is 204,271. For the remaining period of 1937, the figures were: For the remaining days of August, 10,406; for September, 30,982; October, 22,894; November, 18,667, and December, 16,008. Thus the total for the whole year of 1938 will doubtless exceed 300,000 as against 298,847 for the year 1937.

Municipal trailer camp headquarters



Beauty and Practicability Combine at Boulder Dam

I am convinced that the reason why th American people in such enormous number visit Boulder Dam is found in their love fo scenic beauty and panoramic grandeur, both of which are accentuated at Black Canyo by beautiful Boulder Dam, that stupendou structure that fits into the picture with a symmetry and beauty so fascinating that n words, nor any picture in two dimension can convey the full meaning.

The Boulder Canyon project continues t rank with Yosemite and Yellowstone as a chief magnet for the American tourist, an the reason for this sustained interest in thi reclamation project is unquestionably th same, in the main, which leads the multi tudes to those world-famous parks. Not onl do the people come in yearly by hundreds o thousands to Boulder Dam, but many o them come more than once. I personall know of numerous instances in which peo ple have visited this project a second and a third time, solely for pleasure. Thousand of these visitors are from distant parts o the country. They comprise a perfect cross section of our country's people as a whole They go to the Yosemite and to the Yellow stone to drink in the beauty which natur in a lavish mood has provided, and the sam motive brings them here.

At Boulder Dam the visitor not only ha presented to his view some of the rugged est and grandest scenery on the continent but in the midst of this picture he sees a structure so beautiful and so eminently a part of the scenery itself, that his imagina tion is roused by thoughts of what man ha wrought, thoughts of the gifts which enabl engineers of genius to combine the practica and the beautiful, and meditations on man' victory in taming the unruly Colorado an putting it to work.

Boulder Dam in Prospective

Presumably when Commissioner Mead, o beloved memory, Chief Engineer Walter, As sistant Chief Engineer Harper, Chief Design ing Engineer "Jack" Savage, Assistant Chie Nalder, and Chief Electrical Engineer Mc Clellan were fashioning in their minds an in that vast array of drawings the futur dam which was to conquer the Colorad and store its flood waters in the mighties of all reservoirs, to be released as needed t enable an army of farmers to complete thei task of subduing the southwestern deserts and also to supply millions in Californi cities with an augmented water supply, thes supremely practical engineers were givin thought chiefly to the problem of makin it the most up-to-date and consequently th most efficient reclamation and power projec in all the world, because it was to be th most comprehensive in its scope. But his tory seems to show that the greatest engi

neers and architects were also artists touched with the genius of poetry, and assuredly these men, in contriving Boulder Dam, were moved by inspirations for the beautiful. And they had the practical good sense to combine superbly the practical and the pleasing. For, as turned out and standing in its majesty today, their finished product in its charming lines is comparable to those two modern examples of the best taste in construction, the Congressional Library and the Supreme Court building at Washington.

Professional writers by hundreds in newspapers and magazines have tried with only partial success to convey a mental picture of the grandeur of Black Canyon, the grandeur and beauty of Boulder Dam, the beauty of Lake Mead, the charm of that whole area which first meets the eye as one leaves Boulder City and begins the 7-mile trip to the dam, an area which grows more and more rugged as one nears the river and encounters a replica of the Grand Canyon in miniature, a region which would seem to say to any engineer: "I defy you to attempt a road here," and which, nevertheless, has been pierced by a thoroughly safe and paved highway from Boulder City through the very heart of these cliffs and canyons down to the dam, a drop of more than 1,200 feet in 7 miles, and along the crest of the dam into the equally rough regions of Arizona on the far side of the canyon. Those skilled writers having fallen short of success in conveying the true scene to the mind of the reader, no attempt is made here to compete with them, and the writer can only state the facts and his own impressions. For a somewhat adequate understanding the reader is referred to the accompanying pictures. Even these, however, are only relatively satisfactory. For a panoramic picture which may be equal to what is seen by the human eye, we must await perfected photography in three dimensions and true reproduction in color printing.

Memorial Plaque to Labor

Deserving of special mention in any reference to the beautiful lines of the dam is a sculptural work supplied by Mr. Oskar J. W. Hansen of Virginia, in a competition with other nationally famous sculptors, arranged by Secretary Ickes. Flanking a flagpole of steel, 125 feet high, at the Nevada entrance to the highway on the dam, are two massive winged figures in bronze, seated and facing along the crest of the dam and designed, in the words of the sculptor, "to convey the spirit of a nation seated in vigorous consciousness of a reason come of age and armed only with the winged imagination of constructive thought." These figures are seated on a pedestal located in a field of stars. By means of this starry pavement, which at this writing is not quite completed, the Boulder Dam structure "is located for all times astronomically in history, time, and space." By this floor and the bas-reliefs which adorn the two central towers the sculptor indicates "the historic background which produced finally the beings capable of conceiving a cooperative structure such as the dam."

The foregoing extensive references to the

Sailing is enjoyed as a sport on Lake Mead

reasons which appear to account for the continuing popularity of this project with American tourists have seemed worth while for the purpose of establishing in the minds of all readers of the ERA the fact that Boulder Dam, as a tourist attraction of supreme merit, is here to stay.

Lake Mead a Recreational Area

The National Park Service has recreational jurisdiction over Lake Mead and over the area surrounding Boulder Dam and Boulder City, the Bureau of Reclamation having exclusive control over the dam and the town, and that Service is doing its share to make this region attractive for tourists. A concessionaire operates pleasure boats on the lake, for its full length of 115 miles. A permanent "beach" for bathers and for the boat landing is nearing completion, constructed by the National Park Service. Within the next 6 months a paved roadway, starting northerly at right angles to the Boulder City-Boulder Dam highway and running northerly nearly 5 miles, will be constructed by the Federal Bureau of Public Roads for the National Park Service at an estimated cost of $25,000. This road, skirting the future upper line of the lake, will run to the boat landings and the beach, and to the lodge and the cabins which are projected by the concessionaire.

The Bureau of Reclamation has established and is operating within Boulder City a municipal tourist camp for travelers in private automobiles and trailers. The accompanying photograph shows the headquarters office maintained for registration. Rest rooms and showers are provided for the accommodation of registrants. These camp facilities are furnished at 50 cents per day.

It has long been expected by all local officials of the Government that in time Lake Mead would provide the finest bass fishing in the world, because of the enormous area of the lake, its great depth, and the permanently low temperature of the water which is found at a depth of 20 feet below the surface. Plans called and still call for stocking the lake with bass from Government hatcheries, and with stocking the stream below the dam with trout. And it was foreseen that whenever it became widely known that bass in quantities were in the lake and that there were accommodations nearby for fishermen, crowds of fishermen would come. To the surprise of everybody, it has been found this year that the lake is already quite well stocked with bass of acceptable size, and many catches of fish weighing 5 to 7 pounds are common. These facts were puzzling for a time because no bass were "planted" in the lake until two years ago, and they were tiny fellows. But the explanation of the presence of the big bass was found when it was ascertained that back in 1916 some bass were "planted" in the Virgin River, a small stream which flows from the north

Boulder City as it now appears

into the Colorado River just beyond the Moapa Valley. The descendants of those Virgin River bass, now reveling in the limpidly clear water of the lake, are fighting the fishermen who know about them. To enable fishermen to enjoy in rough luxury the pleasures of Lake Mead, it is planned by the National Park Service concessionnaire to build cabins and a lodge, near the lake. These improvements will be situated about 8 miles from Boulder City.

Boulder City Airport

The National Park Service, using the labor of enrollees of the Boulder City CCC camps, has assisted the same concessionnaire in constructing on several hundred acres just west of Boulder City an airport which has been leased to Transcontinental and Western Air, Inc., and the planes of that company plying between Los Angeles and Albuquerque on the transcontinental route, and between San Francisco and Boulder City on a shuttle service connecting with the through service, are finding that the Boulder City airport is one of the best in the country. Improvements to cost some $25,000 and including a terminal office building and passenger station are to begin immediately.

Boulder City as It Now Appears

Boulder City in the post-construction period continues to hold public attention out of all proportion to the size of the town. Three-fourths of the total number of visitors to the dam come through the Las Vegas gateway (in Nevada, 23 miles from Boulder City), and so pass through Boulder City before reaching the dam (7 miles farther on), while the other fourth pass through the Kingman gateway (90 miles from Boulder City) and they see the dam first. Las Vegas is on a transcontinental highway running from Salt Lake City to Los Angeles, and Kingman is on the through highway which runs from Los Angeles to Albuquerque and so on to the east. Completed within recent months is the highway running from Kingman to the dam and thence by the Government's own highway to Boulder City and then by state highway to Las Vegas. This new road is rapidly gaining favor with tourists traveling from the east to the Pacific Coast, because it enables them to include the Grand Canyon and Boulder Dam in a short day's journey and then proceed to Los Angeles, and the same two scenic attractions are reached by the east-bound tourist from Los Angeles, if he comes by the Las Vegas gateway. But whether coming from the westerly side and so reaching Boulder City first, or from the Kingman side and reaching Boulder City after seeing the dam, nearly all stop in Boulder City.

If the visitor is headed toward Boulder City from the Nevada side, he finds himself quickly prepared by the landscape around him for the attractions at the river. In shapes and coloring the desert nowhere else can be more alluring, in the opinion of many travelers. On reaching the town, if not before, the visitor on looking around finds himself within a giant bowl which has a diameter of more than 20 miles, the rim of this bowl being marked by low and jagged mountains of many colors, all devoid of vegetation, and sloping from these heights to its center, which consists of a "dry lake" of several square miles in area, the surface of which is white, the "lake" being many hundred feet lower than the surrounding mountain tops. Boulder City, it is found, lies against the northeasterly interior of this bowl, and reaches to its top, whence is afforded a magnificent view of Lake Mead. The near margin of the lake is 7 miles away, but seems to be only 2 or 3 miles at most, and the farther shores, where the lake loses itself to view by turning behind low hills, are at least 20 miles distant, yet the details of those shores stand out clearly. Immediately to north of the town are two small mountains, separated by a shallow canyon. One of these mountains is black, the other brown. That view captivates many painters.

Boulder City Still a Model Town

Always praised by visitors as notably clean as to streets, alleys, lawns, and buildings and pleasing in the architecture of the more permanent buildings, the town retains this distinction. At one time there were more than 600 cheap cottages constructed by the contractors for their workers; now there are only 165 of these and all of them are owned by local residents, most of them occupied on the project. The Government constructed, in the early days of the project, a total of 100 dwellings for its officials and employees. All of these are still in use, and there is always a considerable waiting list of Government employees who want these houses. Aside from these Government houses, there are 306 houses individually owned, and there are 50 houses constructed by the city of Los Angeles for the employees of its Bureau of Power and Light. There are many apartment buildings.

Every one of these houses is in a setting of clean surroundings. Most of them have lawns, well kept. As a mere detail of sanitary policies, all garbage is deposited in metal cans with metal covers, and all garbage is regularly collected and burned. There are no mosquitoes, and few flies (it should be a flyless town, but our ambitions in that direction are not fully achieved). The town is as nearly free from unnecessary noises as seems possible. Patrons of the hotel (a modern establishment of 100 rooms) frequently mention to the writer, in great satisfaction, the freedom of the hotel from noises and the freedom of the town from noises. Honking of automobile horns, in any part of the town, is forbidden, except for emergency purposes.

There is no drunkenness locally acquired. No alcoholic drink except "3.2" beer is sold. Boulder City is one of the few remaining "dry" towns in the United States. There is no gambling, no vice. During the construction period, the labor turn-over yielded a total of perhaps 20,000 workers on the project. Many of them of course had a criminal record; there were more than 100 ex-convicts at one time. The population through a period of at least 2 years exceeded 6,000. Now it is around 2,500. Yet, from the beginning to the present there have been just two major crimes, one hold-up and one murder (and the culprits in each case were quickly caught and sent to prison). Residents seldom locked their doors, and the unlocked door is still in fashion, though the newcomers are more wary. This does not mean that there were no evil-doers to be handled; but most of them were in the misdemeanor category—wife-beating, family desertion, fighting, petty thefts in dormitories. Those deserving of punishment were expelled from the town for short or long periods, these expulsions amounting in effect of fines, since those expelled were off the pay rolls while away. Expulsion is still the ruling punishment, but on occasion the county's prosecuting attorney at Las Vegas is consulted by telephone.

Contented as they are, the town's residents have nevertheless many problems in which they want assistance. And since the town has no practising lawyer, and never had for any length of time, each day brings its assortment of questions from the people to their town manager for advice and settlement. Thus this official is now more than ever, it seems, required to be an "alcalde" or town arbiter for all the domestic and business troubles that present themselves.

Number of Business Permits Limited

The policy of limiting the number of business permits to the apparent public needs, as fixed in the beginning of Boulder City is still pursued inflexibly. It has happened that with the shrinkage of population there has been a corresponding reduction of the number of business places, in several instances. The contractors on the dam were allowed to operate a great department store. When that store went out of business, the business men of Boulder City found compensations for a smaller population in the removal of the contractors' competition. So that, by and large, it can be said the business community is still prosperous and contented, the exceptions being confined to the very few who built beyond their own needs and against the advice of the Government's representatives. There are but four buildings in which there is empty business space, only three in which there is ground floor space, and one of these buildings has been vacant ever since 1932, except for occasional and brief uses.

A typical Government employee's residence in Boulder City

Though the writer estimates the population at approximately 2,500, the postmaster and others think it is greater. In the municipal water and electric services we have a total of 620 residential accounts (inclusive of the 50 houses owned by the city of Los Angeles), so that the estimate of 2,500 residents may be too low.

School Facilities

Boulder City's pupils for the high school number about 60, and are transported to the high school at Las Vegas by the district, of which the Boulder City area is a part. Congress at the past session appropriated $50,000 for an additional school building for Boulder City, to provide facilities for the lower grades of the high school, but the new building will not be ready under several months and probably will not be in use before September 1939. The town has always had excellent grade schools. Pupils to the number of about 330 are in the grade schools for the new school year.

Boulder City school

Arnold A. Seipel Wins Welding Award

A STUDY on arc-welded scroll cases for hydraulic turbines, similar to those used at the Grand Coulee Dam power plant, has won for Arnold A. Seipel, Denver engineer, an award of $3,764.94.

Mr. Seipel, associate engineer of the United States Bureau of Reclamation, was one of seven Colorado residents announced as winners in the $200,000 industrial award program sponsored during the past 18 months by James F. Lincoln Arc Welding Corporation, Cleveland.

Mr. Seipel, winner of the first prize in the pipes and pipelines division, submitted a design for construction of a large turbine scroll case which he estimated would save 46.7 percent of the actual cost.

Other winners included George B. Cramp, associate engineer; M. E. Nantz, associate engineer; Fritz Heidinger, assistant engineer; and Myron E. Nixon, junior engineer, all of the Denver Office, and George O. Marrs and Asher H. Patten, also of Denver.—*Rocky Mountain News, Denver, September 16.*

California's Golden Girl

ALONG with San Francisco's exposition, next year, Sacramento will have an exposition of her own, in celebration of the centennial of the arrival of Capt. John A. Sutter at Sacramento in 1839, and his construction of "Sutter's Fort" at that place. (It was not until January 1838, however, that Marshall made his discovery of gold on Sutter Creek; a discovery which was the beginning of modern California.) The fort has been fully restored, and now contains a large and varied historical exhibit relating to early American pioneering in California; and, supervised and shown by a curator, the exhibit is already attracting much attention within the State.

To inform the people of the country about the Sacramento exhibit as well worth their attention when they visit the San Francisco exposition, Miss Myrtle Loheit of Sacramento, officially designated as "California's Golden Girl," visited the principal cities of the country during the summer. On September 2, Miss Loheit and her party visited Boulder City and Boulder Dam and Lake Mead; City Manager Ely acting as host in showing them over the project.—*Sims Ely, City Manager, Boulder City, Nevada.*

Belle Fourche Community Events

SUGAR DAY was held at Vale, S. Dak., on August 27, and a large crowd participated in the holiday given to sports, rodeo, and entertainment. Sugar prizes were awarded to winners in the various events.

Meetings of Interest to Federal Reclamation Projects

National Reclamation Association

FOR the first time since the organization of the National Reclamation Association a cabinet officer will be in attendance at its annual meeting this year. Secretary of the Interior Harold L. Ickes has accepted an invitation extended by President O. S. Warden to speak at the seventh annual meeting of the association to be held at Reno, Nev., October 11–13, inclusive.

The board of directors of the association will meet for 2 days ahead of the convention in Reno on October 9–10 to dispose of such business as has accumulated and which may properly come before it for consideration.

The National Reclamation Association was organized by the Governors of the 11 Western States and is made up of representatives of the 15 States bound in the common interest of an insufficient water supply which must be remedied by irrigation practice in agriculture. The entire activities of the association are in the furtherance of the Federal Reclamation policy and the annual meetings provide an opportunity for discussing subjects of mutual interest. This year the recommendations of the Repayment Commission, which recently reported on its investigation of Federal Reclamation projects, including Indian projects, will come up for consideration, and the entire personnel of the commission will be in attendance. The Repayment Commission members are Dr. Charles A. Lory, chairman, of Colorado; George T. Cochran of Oregon; and William R. Wallace of Utah.

Commissioner Page, who is accompanying the Secretary on portions of his trip will be present; also Chief Engineer R. F. Walter and probably other members of the Bureau.

Other speakers scheduled on the program at Reno include Senators Pittman and McCarran, Gov. Richard Kirman, Sr., of Nevada; Representative James G. Scrugham of Nevada; Chester C. Davis, member of the Board of Governors, of the Federal Reserve Board; and Prof. Harlan H. Barrows of the National Water Resources Committee.

President Warden and Mr. Floyd O. Hagie, secretary-manager of the association, have arranged a very attractive program and agenda of business for the Congress which should assist materially in bringing about a discussion of problems affecting Federal Reclamation operations which will come before the next Congress for consideration.

The formal program is scheduled to start the convention on the first day of the meeting, when delegates will be brought up to date on association affairs. Matters coming before the convention will be presented by the present officers of the association as follows:

Dr. O. S. Warden, of Montana, president.

J. R. Fauver, of California, chairman, budget and finance committee.

Senator John B. McColl, of California, chairman, legislative committee.

H. Lloyd Miller, of Washington, Treasurer.

F. O. Hagie, secretary-manager.

A special subcommittee appointed by the Water Resources Committee to review State water legislation will make a progress report at the Reno meeting which will be of great interest to every western State.

Officials of the Reno Chamber of Commerce have arranged a national radio hook-up to broadcast Secretary Ickes' speech to the entire United States.

Oregon Reclamation Congress

THE official call for the twenty-eighth annual session of the Oregon Reclamation Congress is out, the meeting to be held at Redmond, Oreg., October 21 and 22. In notifying the Bureau of Reclamation of this meeting, Prof. W. L. Powers, secretary of the Congress, advised that Redmond was selected because it is situated in the center of a large irrigated area of progressive farmers, and this will afford an opportunity for delegates to observe the work on the north unit of the Deschutes project.

The call states an imposing list of speakers is being contacted and the acceptances assure a splendid program. Special attention will be given to equipment for preparing land for irrigation and to problems of irrigation practice. Space is available for exhibits and the Bureau will have a model of the Grand Coulee Dam, also two photographic exhibits featuring The Story of Reclamation, and Dams Constructed by the Bureau of Reclamation. The first-named picture exhibit will consist of 30 photographs showing the snowcapped mountains (the source of irrigation water supply), the storage of melted snows, irrigation structures to bring the water to the land, and the results of irrigation. The latter named photographic exhibit shows 28 dams constructed by the Bureau of Reclamation, included in which are Shoshone, Arrowrock, Owyhee, and Boulder Dams, each of which at the time of completion represented the highest dam of its kind constructed.

The announcement also states that several legislative problems will be considered, including an important question of jurisdiction in interstate waters of nonnavigable streams.

Commissioner Page, adapting his program to the trip of Secretary Ickes, will be unable to be present in person but has sent a message to the meeting. Mr. C. C. Fisher, in charge of the Deschutes project, was designated as the personal representative of Commissioner Page and addressed the meeting. Another Reclamation official instructed to attend was Mr. B. E. Hayden, superintendent of the Klamath project in Oregon.

The Oregon member of the Repayment Commission, George T. Cochran, has been authorized by the Secretary of the Interior to attend.

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Report of Federal Irrigation Congress

By H. H. JOHNSON, *Superintendent Milk River Project, Montana*

AT THE annual meeting of the Federal Irrigation Congress, held in Torrington, Wyo., September 1–3, the Bureau of Reclamation was represented by L. H. Mitchell, of the Washington office, and H. H. Johnson, superintendent of the Milk River project, Montana, field supervisors of the Operation and Maintenance Division.

The Congress convened on September 1 with G. W. Grebe presiding. About 21 districts from 14 projects were represented by one or more delegates. The first day of the meeting was devoted to the reports of the representatives, relative to conditions, both agricultural and financial, on their respective projects. It is apparent that practically every project has suffered from adverse conditions of some nature during the past season—grasshoppers in the grain and alfalfa, blister beetle or web worm in the sugar beets, purple top in the potatoes, and various other insect infestations. The Belle Fourche project only complained of a short water supply. Market conditions appear to be unfavorable on all projects and a poor price prospect is general. The full payment of 1938 construction charges was in almost every case declared to be impossible or extremely burdensome, under prevailing conditions. The discussions as a whole, however, were fair and considerate.

The morning of the second day was devoted principally to a discussion of the report of the Repayment Commission, Dr. Charles A. Lory and Judge George T. Cochran, members of the Commission, having arrived on the previous evening. The feeling expressed generally was that the report reflected a careful study and analysis of conditions by the Commission, that it was complete and comprehensive, and that if the recommendations were enacted into law, considerable relief would result to most projects. The point was stressed that some adjustment of 1938 charges was essential.

Considerable discussion was had over the plans proposed for the determination of the repayment rates as suggested by the report. Some projects seem to think the 5-percent normal base too high, but practically all seemed to concur in the sliding principal. All were in favor of discontinuance of joint liability.

It is evident that a great number of the projects favor a repayment plan based upon net rather than gross revenue. A. N. Mathers, of the Gering Fort Laramie Irrigation District, was the most outspoken proponent of this plan.

As a representative of the Repayment Commission, Judge Cochran outlined the underlying principles by which the members were guided in the preparation of the report and the recommendations embodied therein. He explained that although net revenue was not specifically set out as a basis for the determination of the repayment rate, owing to administration difficulties which would be involved, yet it was after all the controlling factor in the ability to pay and was so considered in the recommendations. In spite of the minor objections it is believed that the delegates as a whole were favorable to the report.

On the afternoon of the second day the entire group was taken for a trip over the project and to the Guernsey Dam. The third day was devoted principally to resolutions and the election of officers. The officers elected for the ensuing year are as follows:

G. W. Grebe, Kuna, Idaho, president.

J. S. Reece, Payson, Utah, secretary-treasurer.

EXECUTIVE COMMITTEE

R. O. Chambers, Minatare, Nebr.
Albert Groskinsky, Sidney, Mont.
Wm. J. Dodd, Delta, Colo.
W. W. Hudson, Veteran, Wyo.
G. W. Grebe, Kuna, Idaho.
Frank L. Dickerson, Wilder, Idaho.

Among other helpful resolutions passed at the meeting, those particularly affecting the Bureau of Reclamation included the following:

Resolution No. 1 endorses the report of the Repayment Commission appointed by Secretary of the Interior Ickes and promises to recommend to the Congress of the United States that legislation be passed embodying the program laid out by the Commission and the adoption of the repayment plan offered therein.

Resolution No. 2 proposes to recommend to the Congress of the United States that the work of the Repayment Commission be continued and that said Commission make such further recommendation for deferments as may be necessary to meet the exigencies of the times until the repayment program recommended by the Commission may be enacted into law and put into effect on the various projects.

This resolution further recommends that the Secretary of the Interior be authorized to make such adjustment of construction payments as may be recommended by the Repayment Commission.

Resolution No. 3 expresses approval of the use of CCC camps on Reclamation projects and urges the continuance and extension of the use of such camps in the improvement and completion of these projects, thereby contributing to the welfare of the projects and increasing the security of the United States in the funds advanced for the construction of these projects.

Resolution No. 4 declares the utmost confidence of the Federal Irrigation Congress in the Repayment Commission and its entire membership and the fullest appreciation of the valuable service it has rendered to the members of the Federal Irrigation Congress and to the cause of reclamation in general.

These resolutions were drafted by a committee appointed by the Federal Irrigation Congress and signing as follows:

R. O. Chambers	Roy T. Taylor
J. B. Fuller	G. M. Olsen
J. H. Mueller	G. W. Grebe

During the sessions L. H. Mitchell delivered his illustrated lecture on the practical Use of Soil and Water, and H. H. Johnson presented a paper on Resettlement.

Conquering Climate

(*Continued from page 198*)

named, will be the largest structures ever built by man, surpassing even Boulder Dam in their size and in the work they will be able to do for the benefit of man.

These and the other smaller but still important projects now under construction hold a great promise for the West. In years to come the power from their dams and the water from their reservoirs will work side by side in arid valleys to create new empires rivaling those which already, in like manner, have sprung from the sagebrush. They will support homes, farms, and cities, and bring renewed hope to hundreds of thousands. Prosperous new communities will take their place within these States and pour additional wealth into the trade channels of the whole Nation.

These things we have a right to predict, knowing as we do from the records of Reclamation that similar achievements have resulted from other projects.

Adhere to a sound and wise reclamation program and you will protect the future of the West. Abuse it to satisfy a present greed, either for land at a reckless cost or for political power, and you will drive your children and their children out into the wastelands instead of sheltering them in safe homes on projects yet unbuilt. Today engineering skill, science, and public approval are ready to support a reclamation policy that is economically sound and socially desirable.

Bureau of Reclamation Meeting at Boulder City

COMMISSIONER PAGE has called a conference of certain Bureau personnel to meet at Boulder City, Nev., Saturday, October 15. Secretary Ickes will be present and such personnel as is listed on page 220 under the head Reclamation Organization Activities.

The program tentatively outlined in Washington is as follows:

Saturday, October 15

		Presiding
9:00 a. m.	Assembly and announcements	Commissioner and Chief Engineer.
9:30 a. m.	Visit of Secretary of Interior; general discussion administration power policies, etc.	
12:00 noon–1:30 p. m.	Luncheon intermission.	
1:45 p. m.	Legislation, general	Chief Counsel Cheadle.
2:30 p. m.	Legislation, repayment.	
5:00 p. m.	Adjournment.	

Sunday, October 16

9:00 a. m. Assembly

DIVIDED SESSIONS

[Construction and operation and maintenance discussions]

Construction	*Operation and maintenance*
Chief Engineer Walter, presiding.	G. O. Sanford, Chief Operation and Maintenance, presiding.
Right-of Way Acquisition, discussion led by District Counsel Coffey.	Settlement.
Award of contracts.	Revision of application ratings, etc.
Change orders.	Public notices.
Labor relations.	Excess lands.
Purchase of materials.	Maintenance problems.
General.	General.

LUNCHEON

Joint session—Commissioner presiding

Personnel	George A. Bonnet, leading discussion.
C. C. C.	L. S. Davis, leading discussion.
Relations with press and Division of information	Wm. E. Warne or Philip D. Dickinson leading discussion.
Finances and Accounting	Wm. F. Kubach, leading discussion.
Accident prevention	L. S. Douglass, leading discussion.
General.	

Monday, October 17

9:30 a. m. Assembly at office; trip through dam and power house.
12:30 p. m. Luncheon; trip up Mead Lake if desired.

Tuesday, October 18

A. M.

Washington & Denver personnel available for conferences on special questions

Orland CCC Camp Educational Program

ORLAND, Calif., is taking considerable interest in CCC Camp BR-78. This camp has been incorporated in the Orland Elementary School District, the trustees of which have voted to establish a branch school in the camp with Educational Director F. D. Corbett as principal. Four teachers will be employed through the teachers' emergency relief fund, regular California State textbooks will be used, and all grades from the first to the eighth will be taught. Regular diplomas will be granted those completing the course.

It is stated that this school is the first regularly constituted grammar school giving credit toward graduation to be established in any CCC camp in the United States, and its progress will be watched with interest by educators in every section of the country.

Visitors at Coulee Dam

EVERY CONTINENT, and points as remote as Iceland and New Zealand were represented by visitors at the Grand Coulee Dam during the summer. More than a million persons are estimated to have viewed the project since construction work began 5 years ago. This year's total is expected to run above 300,000, the estimated attendance last year.

During August, usually the month of greatest tourist travel in the West, the visitors to the dam numbered more than 44,000. On Labor Day the attendance was about 5,000, on the preceding Saturday about the same, and on the intervening Sunday 7,000. Every State in the Union, and every continent, as well as remote islands, were represented. Less than 1 in 10 registers in the guest books. On holidays and Sundays the percentage registering is very low owing to unavoidable congestion at the desks.

The totals registered in August were:

Washington	4,437	New Hampshire	8
California	1,301	Arkansas	8
Montana	478	West Virginia	7
Idaho	467	Georgia	6
Oregon	455	Mississippi	5
Illinois	388	South Carolina	4
Minnesota	254	Maine	3
Iowa	232	Delaware	2
Kansas	228	Rhode Island	2
Nebraska	223	Hawaii	21
Ohio	188	Alaska	17
New York	178	Canal Zone	3
Wisconsin	172	Philippines	2
Michigan	161	British Columbia	644
Colorado	159	Alberta	386
Texas	152	Saskatchewan	162
North Dakota	148	Ontario	60
Missouri	139	Manitoba	38
Utah	137	Quebec	8
Oklahoma	118	New Brunswick	2
South Dakota	110	England	13
Pennsylvania	105	China	5
Indiana	83	India	5
Mississippi	58	Ireland	4
Wyoming	57	Africa	4
New Jersey	55	Mexico	3
Florida	54	New Zealand	3
Arizona	51	Australia	2
Washington, D. C.	43	Sweden	2
Maryland	39	Scotland	2
Nevada	30	Argentina	2
Kentucky	27	Korea	1
Tennessee	24	Germany	1
Alabama	21	Netherlands	1
Virginia	19	Ecuador	1
Louisiana	17	Iceland	1
New Mexico	15		
Connecticut	12		
Vermont	11		
North Carolina	10	Total	12,294

Shoshone Teachers Organize

A Parent-Teachers Association was organized recently at Powell, Wyo. This organization was organized to help promote better understanding between the parents and teachers and to improve the local schools.

NOTES FOR CONTRACTORS

Specification No.	Project	Bids opened	Work or material	Low bidder		Bid	Terms	Contract awarded
				Name	Address			
		1938						1938
787	Columbia Basin, Wash	Aug. 18	Three 108,000-kilovolt-ampere generators for units L-1, L-2, and L-3, Grand Coulee power plant.	Westinghouse Electric & Manufacturing Co.	East Pittsburgh Pa	$2,611,000.00	Net	Aug. 30
793	Yakima-Roza, Wash	Aug. 5	Construction of Roza diversion dam, bench flume, and railroad bridge	Morrison-Knudsen Co.	Boise, Idaho	526,860.00		Aug. 29
792	Central Valley, Calif	July 11	Construction of Sacramento River bridge, first crossing, relocated Southern Pacific Railroad.	Clifford A. Dunn	Klamath Falls, Oreg.	[1] 173,320.00		Sept. 7
				American Bridge Co.	Pittsburgh, Pa.	[2] 569,100.00	F. o. b. Gary, Ind. (steel)	Do.
1083-D	Pine River, Colo.	June 30	Construction of relocated road at Vallecito Reservoir.	Martin Wunderlich Co.	Jefferson City, Mo.	16,120.00		Aug. 25
1097-D	Colorado-Big Thompson, Colo.	July 22	Materials for steel warehouses at Estes Park headquarters and Government camp at Green Mountain Dam.	Minneapolis-Moline Power Implement Co.	Minneapolis, Minn.	12,600.00		Do.
1102-D	All-American Canal, Ariz.-Calif.	Aug. 10	3 trash cars for handling debris removed by traveling trashrack rakes.	Lake Shore Engine Works	Marquette, Mich.	988.00	Discount 1 percent	Aug. 31
1103-D	Colorado-Big Thompson, Colo.	Aug. 11	Electrical conductor and accessories for transmission lines.	Aluminum Co. of America	Washington, D. C.	[3] 39,451.08	F. o. b. Massena, N. Y.	Sept. 7
				do	do	[4] 22,038.59	do	Do.
				do	do	[5] 40,060.79	do	Do.
1104-D	Kendrick, Wyo.	Aug. 15	Precast reinforced concrete pipe	Collins Concrete & Steel Pipe Co.	Portland, Oreg.	[2] 11,287.00	F. o. b. Casper, Wyo.	Do.
1107-D	do	Aug. 23	Pipe, fittings, valves, and pipe hangers for Seminoe power plant.	Standard Sanitary Manufacturing Co.	Denver, Colo.	[6] 4,066.00	F. o. b. Parco, Wyo. Shipping point Cincinnati, Ohio. Discount 2 percent.	Sept. 6
				do	do	[7] 3,995.00	F. o. b. Pittsburgh, Pa. Discount 2 percent.	Do.
				John W. Beam	do	[8] 310.00	F. o. b. Parco, Wyo. Discount ½ percent.	Do.
1109-D	Yakima-Roza, Wash.	Aug. 22	Structural steel for Northern Pacific Railroad bridge over Yakima Ridge Canal and service bridge on Roza diversion dam.	American Bridge Co.	do	10,921.00	F. o. b. Gary, Ind.	Sept. 7
24,612-A	Gila, Ariz	Aug. 11	Insulators (30,000)	Hendrie & Bolthoff Manufacturing & Supply Co.	do	22,500.00	F. o. b. Baltimore, Md.	Do.
A-38,122-A	Columbia Basin, Wash.	Aug. 12	Steel reinforcing bars (3,817 tons)	Bethlehem Steel Co.	San Francisco, Calif.	194,090.88	F. o. b. Odair, Wash. Discount ½ percent on b. p. v.	Do.
1108-D	Colorado-Big Thompson, Colo.	Aug. 22	Two 10-ton, motor-operated, traveling cranes for Estes Park and Green Mountain warehouses.	Cyclops Iron Works	do	6,500.00	Discount 1 percent	Sept. 14
1110-D	Colorado River, Tex.	Aug. 25	Two 26- by 28-foot bulkhead gates for diversion conduits at Marshall Ford Dam.	Hansell-Elcock Co.	Chicago, Ill.	23,680.00		Do.
1111-D	Buffalo Rapids, Mont	Aug. 24	Plate-steel discharge manifold and appurtenances.	Commercial Iron Works	Portland, Oreg.	[6] 1,907.00		Sept. 15
	Owyhee, Oreg.-Idaho.		Plate-steel penstock, discharge pipe, and appurtenances for Succor Creek pumping plant No. 2.	McCulloch & Sons	do	[7] 918.00	Discount 2 percent	Sept. 10
B-47252-A	Central Valley, Calif.	Aug. 23	Steel reinforcement bars (791,567 pounds).	Bethlehem Steel Co.	Bethlehem, Pa.	21,926.41	Discount ½ percent (b. p. v. $0.075 less).	Sept. 14
794	Shoshone-Heart Mountain, Wyo.	Aug. 31	Earthwork, tunnel, bench flumes, canal lining and structures, Heart Mountain Canal, stations 920 to 947+30 and 981+95 to 1229.	Barnard-Curtiss Co.	Minneapolis, Minn	304,850.00		Do.
788	Columbia Basin, Wash	Sept. 7	Turbines, governors, and generators for station service units, Grand Coulee power plant.	The Pelton Water Wheel Co.	San Fransico, Calif	[1] 106,498.00		Sept. 26
				Woodward Governor Co.	Rockford, Ill.	[2] 19,236.00		Do.
				Westinghouse Electric & Manufacturing Co.	Denver, Colo.	[9] 193,480.00	F. o. b. East Pittsburgh	Do.
46,174-A	Colorado-Big Thompson, Colo.	Sept. 9	Poles and cross arms	Oeser Cedar Co.	Bellingham, Wash.	[1] 25,057.00	F. o. b. Orofino, Idaho, and Bellingham, Wash. Discount ½ percent.	Sept. 26

[1] Schedule 1. [2] Schedule 2. [3] Schedule 4. [4] Schedule 5. [5] Schedule 6. [6] Item 1. [7] Item 2. [8] Item 3. [9] Schedule 3.

Articles on Irrigation and Related Subjects

ALL AMERICAN CANAL

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AVERILL, WALTER A.

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Richland County Fair, Montana Lower Yellowstone Project

THE Richland County Fair which was held August 29–31 exceeded any fair held in that county during the past few years, not only in entertainment, but in agricultural and stock exhibits. The display which was sponsored by the County Extension Service and the CCC Camp BR–30 on various types of noxious weeds and the importance of eradicating them attracted much attention.

Sun River Development

THE appearance of the Sun River project is materially improved owing to activities of the Farm Security Administration and other settlers occupying lands originally farmed on a commercial basis.

Minidoka Sugar Beets

AN unusually heavy yield of sugar beets for the Minidoka project is predicted for this fall, estimated at about 167,000 tons, or an average of 13.5 tons per acre for the 12,514 acres planted.

Power Development at Boulder Dam

By RUPERT B. SPEARMAN, *Assistant Engineer*

IT IS now nearly 2 years since President Franklin Delano Roosevelt pressed the golden key at Constitution Hall in Washington, D. C., starting the first generator in the Boulder power plant. During this period, installation of generating units has been carried forward, until today the installed generating capacity is surpassed by only one other, the Dnieprostroy plant in southwest Russia.

The present installed capacity of the Boulder plant is 630,000 horsepower. The Dnieprostroy plant has a rated capacity of 810,000 horsepower. The ultimate installation at Boulder of 1,835,000 horsepower will be more than twice that of the plant in Russia and greater than any of the other large hydroelectric developments at present in the United States—Niagara, 452,500; Conowingo, 378,000, ultimate 594,000; and Wilson 260,000, ultimate 610,000 horsepower.

The ultimate installation calls for fifteen 115,000 horsepower and two 55,000 horsepower vertical hydraulic turbines, and eleven 60-cycles and four 50-cycle 82,500 kilowatt, and two 60-cycle, 40,000 kilowatt generators. Also included in the plant are two 3,500 horsepower Pelton water wheels and two 2,400 kilowatt generators for the generation of station service energy. The larger turbines exceed in capacity the largest manufactured previously, namely, the 90,000 horsepower units in the Dnieprostroy plant in Russia.

The City of Los Angeles and Nevada-California Electric Corporation switch yards and a portion of the transmission lines carrying power from Boulder power plant

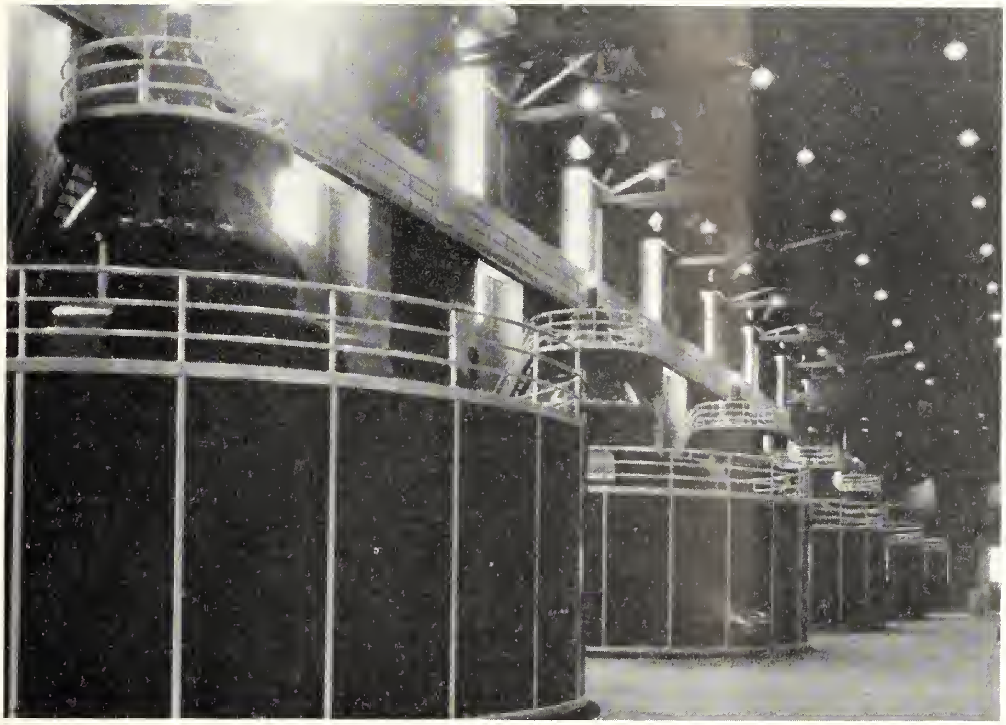
Looking downstream through turbine galley tower in the Nevada wing

The primary or firm energy available is defined as 4,330,000,000 kilowatt-hours per year for the first year of operation subject to a diminution each year thereafter by 8,760,000 kilowatt-hours per year. Of this, 4,240,000,000 kilowatt-hours may be termed the basic firm energy and the remaining 90,000,000 kilowatt-hours, which was made available by construction of the dam to a height greater than that originally contemplated, may be termed the excess firm energy. The basic firm energy has been allocated as follows: 36 percent to the States of Arizona and Nevada; 36 percent to the Metropolitan Water District of Southern California, to be used for pumping on its Colorado River aqueduct; 15.8054 percent to the city of Los Angeles; a total of 4.0946 percent to the cities of Burbank, Glendale, and Pasadena; 7.2 percent to the Southern California Edison Co.; and 0.9 percent to the Nevada-California Electric Corporation. The entire excess firm energy has been allocated to the city of Los Angeles. Energy allocated to but unused by the States, which may be withdrawn by the States upon giving proper notice, has been assigned as follows: 55 percent to the city of Los Angeles; 40 percent to the Southern California Edison Co., and 5 percent to the Nevada-California Electric Corporation. The only energy at present in use by the States is 13,000,000 kilowatt-hours per year withdrawn by the State of Nevada.

It is estimated that secondary energy available will average 1,678,000,000 kilowatt-hours per year under 1938 conditions of river development, and 1,076,000,000 kilowatt-hours per year under 1988 conditions, or a yearly average diminution of about 12,000,000 kilowatt-hours per year.

For operation, the plant has been divided into two systems—one for public agencies purchasing energy, and the other for private concerns. The Bureau of Power and Light of the City of Los Angeles will operate for itself and other public agencies, and the Southern California Edison Co. will likewise operate machines, generating power for itself and other private concerns.

During early October of the same year, installation of the first of the four 115,000 horsepower units in the Nevada wing was completed, and on October 9 the first power was transmitted to Los Angeles. This event was celebrated in Los Angeles by a "Pageant of Light" with huge arc lights on the city hall energized by electricity from the Boulder



The Nevada generator room looking downstream

power plant. It was not until October 22, that regular service was started by this machine, unit N–2.

Installation was rapidly completed on units N–1, N–3, and N–4, and on March 18, 1937, all four had been placed in service. During this same period, one of the 55,000 horsepower units, A–8, was installed and on August 16, 1937, it was placed in operation generating energy for delivery to the Nevada-California Electric Corporation.

Installation of two additional 115,000 horsepower units, N–5 and N–6, was started in 1937 to supply power to the Metropolitan Water District. One of these, unit N–5, was completed in June of this year and is temporarily supplying energy to the Los Angeles system. Unit N–6 is practically completed and will be ready for operation in September. Turbines, generators, and auxiliary equipment for units A–6 and A–7 are being manufactured, and installation will be started this fall for delivery of power to the Southern California Edison Co. some time during 1939. As the demand increases, other units will be installed. Announcement has just been made that the city of Los Angeles will build a third line to increase its present transmission capacity.

Each wing of the U-shaped powerhouse is designated by the State in which it is located. The units are numbered, beginning with the first unit in the upstream end of the plant and are prefixed with an N or an A to show whether they are located in the Arizona or Nevada wing. Units N–1 to N–4, inclusive, and A–1 have been allotted to the city of Los Angeles and smaller municipalities; units N–5 to N–8, inclusive, to the Metropolitan Water District; units A–2 and A–3 for the States' use; A–4 to A–7, inclusive, to the Southern California Edison Co.; and A–8 and A–9 (the 55,000 horsepower machines) to the Nevada-California Electric Corporation. All units, except the four to be installed for the Southern California Edison Co., will operate at 60 cycles per second. These four will operate at 50 cycles, but have been designed to operate efficiently at 60 cycles if such is desired.

The initial installation of units N–1 to N–4, inclusive, unit A–8, and the two station service units was started during the summer of 1935. By September 1936, the installation of the two 3,500 horsepower station service units had been completed, and on September 9, 1936, President Franklin Delano Roosevelt pressed a golden key on a platform in Constitution Hall in Washington, D. C., starting the first generator (one of the station service units) in the Boulder power plant. The President, dramatically closing his address to the delegates to the Third World Power Conference and the Second Congress of the International Commission on Large Dams, said, "Boulder Dam, in the name of the people of the United States, to whom you are a symbol of greater things in the future, in the honored presence of guests from many nations, I call you to life.

Los Angeles First Consumer

The first customer for power was the city of Los Angeles. On November 1, 1937, the Bureau of Reclamation terminated a contract with the Nevada-California Electric Corporation, for the purchase of construction energy and started delivery of power to Boulder City from the Boulder plant. Delivery of a portion of the State of Nevada allotment to the Southern Nevada Power Co. of Las Vegas, Nev., was started in March 12, 1937. By June 1, 1937, the storage of water in Lake Mead was adequate for the supplying of firm energy, and on that date purchasers of energy were notified by the Secretary of the Interior that firm power was available. With this announcement, delivery of power to Burbank, Glendale, and Pasadena, Calif., was commenced. Later in the summer, unit A–8 was completed, and delivery of power to the Nevada-California Electric Corporation was started on August 16, 1937. The Lincoln County Power District of Nevada received its first portion of Nevada's power on May 3, 1938. The Needles Gas & Electric Co. of Needles, Calif., and the Citizens' Utilities Co. of Kingman, Ariz., recently contracted for a portion of the power allotted to the Metropolitan Water District, which the district will be unable to use for a period ending in 1954.

The Needles concern will receive energy beginning September 29, 1938, and it is ex-

Boulder Dam and power plant

One of the transmission towers comprising the City of Los Angeles transmission line

pected the Kingman concern will be ready to receive energy late in October. The Metropolitan Water District plans to take energy this fall to pump water into the various reservoirs along the Colorado River aqueduct. The normal operation of its contract will require the Southern California Edison Co. to start taking energy, under its allotment, on June 1, 1940; but it is expected that it will start taking energy at a much earlier date under some temporary arrangement.

Growth of Power Production

Power production has grown from 6,125,444 kilowatt-hours in October 1936, when only one unit was operated, and then for only a few days, to between 120,000,000 and 130,000,000 kilowatt-hours each month this year. During the past fiscal year 1,452,285,000 kilowatt-hours of electrical energy were generated, of which amount 1,136,011,638 kilowatt-hours were delivered to the city of Los Angeles; 23,196,297 to Burbank, 60,658,668 to Glendale, 69,490,827 to Pasadena, 13,688,847 to the State of Nevada for resale to the Southern Nevada Power Co., of Las Vegas, Nev., and the Lincoln County Power District, 120,028,115 to the Nevada California Electric Corporation, 4,553,750 to ultimate consumers in Boulder City, and 13,929,455 kilowatt-hours were used for station service and by the Bureau of Reclamation in Boulder City. Transformer and other losses amounted to 10,127,103. The income for the above amounts of power was $1,888,132.84, and has been applied toward the repayment of the cost of the project. Production to June 30, 1938, amounted to 2,046,924,000 kilowatt-hours. Primary or firm energy is sold for 1.63 mills per kilowatt-hour at transmission voltage, and for secondary energy 0.5 mill per kilowatt-hour at transmission voltage.

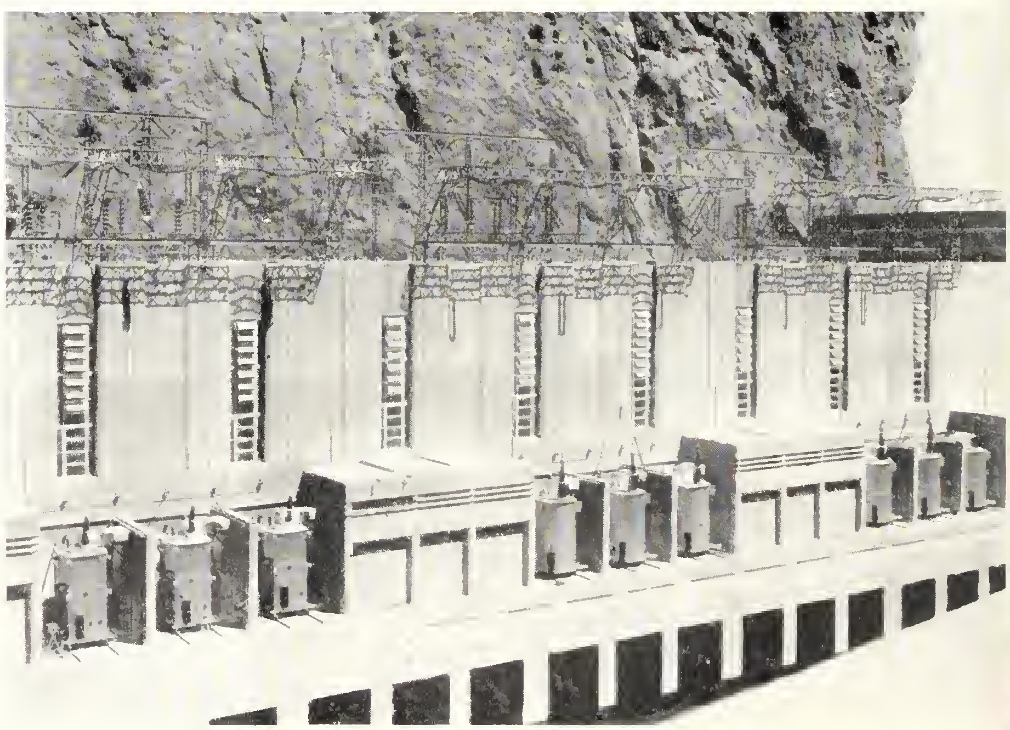
Transmission Lines

The contractors for power will provide and maintain transmission facilities to transmit the energy to points of use. Today there are 10 transmission lines leading away from the Boulder Power Plant for delivery of power in Arizona, Nevada, and southern California. Seven of these lines are in operation, two will be placed in service this fall, and the other probably in 1939. Surveys are now being completed for a third line to Los Angeles.

The most notable of these lines are the two 60-cycle 3-phase circuits, each 266 miles long, to Los Angeles, constructed by the Bureau of Power and Light of that city. Each of these two lines was designed for a voltage of 287,500 volts on the sending end and 275,000 volts on the receiving end, the highest transmission voltage ever used in commercial operation. The reliable operating capacity of the two circuits is considered to be 240,000 kilowatts with a possible peak capacity of 300,000 kilowatts. The third line, expected to be completed next year, is similar. In addition to the energy for its own use, the Bureau of Power and Light of Los Angeles transmits the energy allocated to the cities of Burbank, Glendale, and Pasadena.

Two 230,000-volt, 3-phase lines have been constructed—one a 60-cycle circuit by the Metropolitan Water District for delivery of

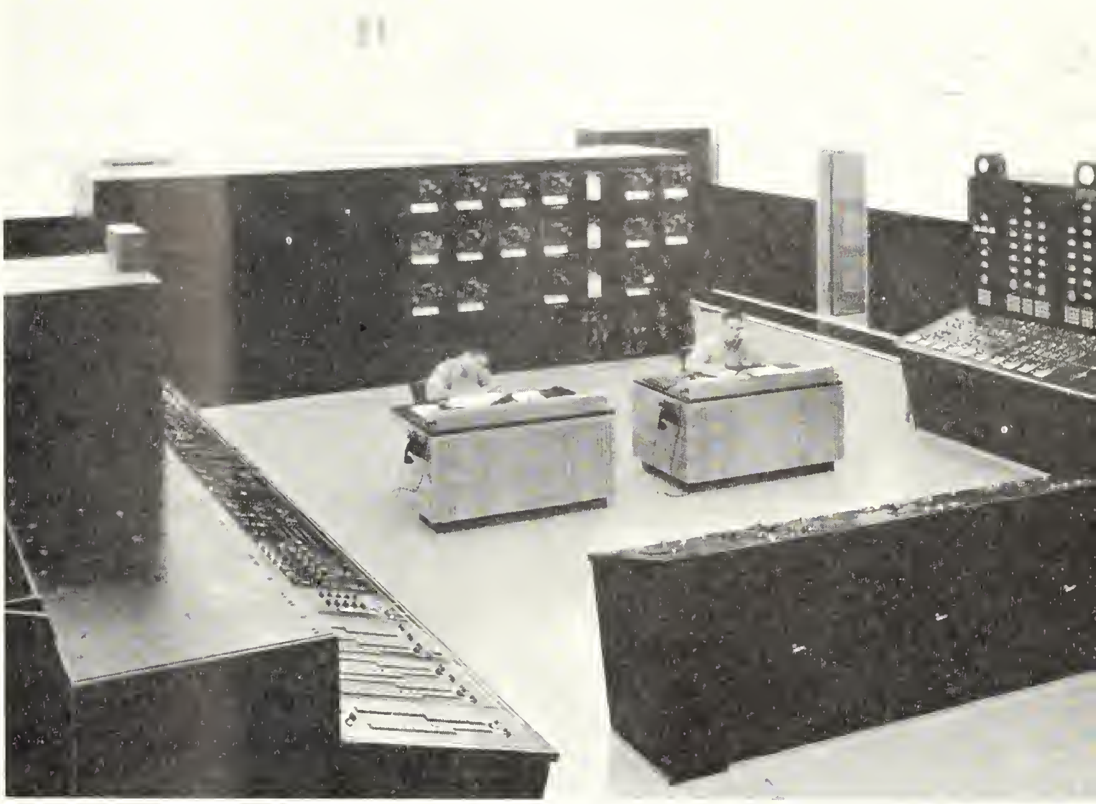
A portion of the Nevada wing of the power plant showing transformer banks



power to pumping plants along the Colorado River Aqueduct, and the other a 50-cycle, 3-phase circuit by the Southern California Edison Co. for transmission of power to its system in southern California. The Nevada-California Electric Corporation is using the same line by which it transmitted power to the project for construction purposes. This line operates at 138,000 volts and is a 60-cycle 3-phase circuit. Three 69,000-volt, 60-cycle, 3-phase circuits have been built, one by the Lincoln County Power District, to Pioche, Nev.; one by the Needles Gas and Electric Corporation to Needles, Calif., which will also supply energy to Searchlight, Nelson, and Eldorado Canyon in Nevada, for mining developments; and the third line to Kingman, Ariz., by the Citizens' Utilities Co. in that city. The Kingman line will also supply Chloride, Oatman, Gold Road, and Catherine, Ariz. Thirty-three thousand volt, 60-cycle, 3-phase lines have been built to Boulder City by the Bureau of Reclamation and to Las Vegas, Nev., by the Southern Nevada Power Co.

The rate of growth of the demand for power from the Boulder power plant in southern California, Nevada, and Arizona has far exceeded previous expectations. The ever-increasing population and industrial development in the Los Angeles area, the need of cheaper energy in the States of Arizona and Nevada for mining developments, have created that demand.

The Colorado River Commission of Nevada is actively engaged in studies concerning the use of electrical energy in the central and southern part of the State. An organization called the Boulder Dam Power Transmission Association of Arizona has been formed and now has thousands of members for the promotion of the use of the State's share of Boulder Dam power. It will not be many years before the Boulder power plant will be operating at capacity.



The main control room for the operation of units for public agencies in central section of power plant

Progress of Investigations of Projects

Arizona-California, Colorado River Valleys surveys.—Work was continued on the preparation of the aerial mosaic.

California, Kings River Pine Flat project.—The assembly and review of data were continued and topographic surveys and diamond drilling were initiated at the Tehipite dam site.

Colorado, Blue River transmountain diversion.—Water supply studies were completed and the report on this feature drafted except for data on power production. All preliminary designs are complete except those for the power plant, and the drafting of the general report is in progress.

Colorado, eastern slope surveys.—Work was continued on the water supply studies for the North Republican River project and on drafting the reports on the Trinidad project and the Cuchara silt surveys. The report on the Hugo and Chivington projects was completed and submitted to the Commissioner for review.

Colorado, western slope surveys.—Topographic surveys, geologic studies, and hydrometric investigations were continued for the enlarged Paonia project. Water supply studies were continued for the Collbran, La Plata, and Troublesome projects, and work was continued on the preparation of a draft of report on the Florida Mesa project. Report on the Paonia project was submitted to the Commissioner for review.

Idaho, Cabinet Gorge investigations.—Water supply and financial studies and the preparation of draft of report were continued.

Idaho, Southwest Idaho investigations.—Surveys were continued on various dam sites and conduit lines within the Salmon River watershed. Reconnaissance surveys were made to determine storage possibilities in the Mountain Home area. Surveys and estimates were completed for highway and railroad relocation at the Cascade Reservoir. Water supply studies and the preparation of a draft of report were also continued.

Idaho, Snake River storage—South Fork.—Foundation explorations by diamond drilling and geological examinations were continued at the Elk Creek dam site.

Montana, Marias investigations.—Surveys and reconnaissance examinations were continued for dam and reservoir sites and canal lines, with a view of development of the best plan for the irrigation of the project lands. Land classification surveys of the project area were continued.

Oklahoma, Fort Supply project.—Surveys and field estimates were continued.

Oklahoma, Kenton project.—The report on this project was approved during the month and distributed to interested parties.

Oregon, Canby project.—The report on this project was approved during the month and distributed to interested parties.

Oregon, Grande Ronde investigations.—Work was continued on the preparation of a draft of report on these investigations.

South Dakota, Black Hills investigations.—The report on the Angostura project was approved during the month and distributed to

(Continued on page 216)

Addresses at National Reclamation Association at Reno

October 11

What About Reno?—Mayor John A. Cooper, Reno, Nev.
The State of Nevada—Governor Richard Kirman, Sr., Carson City, Nev.
The President's Message—Dr. O. S. Warden, Great Falls, Mont.

October 12

Homes or Havoc—Commissioner John C. Page, Washington, D. C.
Construction Progress in Reclamation—Engineer R. F. Walter, Denver, Colo.
Looking Ahead for Reclamation—John W. Haw, St. Paul, Minn.
The History of Reclamation—Senator Key Pittman, Tonopah, Nev.
Problems of the Water Users—And Possible Improvements—D. D. Harris, Ogden, Utah.
Reclamation—The Repayment—Dr. Charles A. Lory, Fort Collins, Colo.
Discussion by: George T. Cochran, LaGrande, Oreg.
Wm. R. Wallace, Salt Lake City, Utah.
G. W. Grebe, Kuna, Idaho.

October 13

Natural Resources of the West—William E. Hammond, Minneapolis, Minn.
Fundamental Principles of Water Planning—Prof. Harlan H. Barrows, Chicago, Ill.
National and Regional Planning for our Country's Waters—L. Ward Bannister, Denver, Colo.
The Water Resources of the Nation—Their Control and Use—Fred D. Beneke, Memphis, Tenn.
The First Reclamation Farmer—Senator Pat McCarran, Reno, Nev.
The Industrial West—George W. Malone, Reno, Nev.
The Place of Irrigation in Agriculture—Hon. Chester C. Davis, Washington, D. C.
Friendly Messages to Reclamation—President O. S. Warden.
Conditions Affecting Western Development—Hon. James G. Scrugham, Reno, Nev.
Conquering Climate—Hon. Harold L. Ickes, Washington, D. C.

Reports

October 11

Budget and Finance Report—J. R. Fauver, Exeter, Calif.
Legislative Committee Report—John B. McColl, Redding, Calif.
Treasurer's Report—H. Lloyd Miller, Sunnyside, Wash.
Secretary-Manager's Report—Floyd O. Hagie, Washington, D. C.

October 12

Needed Water Laws in the West—Report of Chairman Subcommittee, N. R. C.

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THE RECLAMATION ERA • OCTOBER 1938

CUT ALONG THIS LINE

COMMISSIONER,
Bureau of Reclamation,
Washington, D. C.

(Date) ....

SIR: I am enclosing my check [1] (or money order) for $1.00 to pay for a year's subscription to THE RECLAMATION ERA.

Very truly yours,

October 1938

(Name) ....

(Address) ....

....

[1] Do not send stamps.

NOTE.—36 cents postal charges should be added for foreign subscriptions.

Colorado-Big Thompson Project Supervising Engineer Appointed

SECRETARY of the Interior Harold L. Ickes has announced the appointment of Porter J. Preston, Senior Engineer of the Bureau of Reclamation with offices in Denver, Colo., as supervising engineer of the Colorado-Big Thompson Federal Reclamation project.

Mr. Preston was in charge of the preliminary investigations and prepared the report on this project, which is designed to divert water from the headwaters of the Colorado River through a tunnel 13.1 miles long under the Continental Divide to irrigated areas in northeastern Colorado which are now sorely in need of a supplemental water supply.

As supervising engineer, Mr. Preston will have general administrative charge of the construction of the project, including the tunnel, Green Mountain and several other dams, six power plants, canals, transmission lines and pumping plants. The project, which is estimated to cost completed approximately $41,600,000, is just now going into construction. The first major work to start will be the construction of Green Mountain dam and power plant. This will be begun this fall. Headquarters for the project will be at Estes Park, Colo.

Born in 1870 at Grinell, Iowa, Mr. Preston graduated in civil engineering from Colorado State College in 1892. Until 1917 he was engaged in various engineering activities, many of them in connection with private irrigation enterprises, and in 1917 he entered the employ of the Bureau of Reclamation.

During the ensuing 2 years he was engaged in an investigation of the All-American Canal, then being proposed. From June 1920 until February 1921 he was superintendent of the Uncompahgre project in Colorado. He then was transferred as superintendent to the Yuma project in Arizona and in 1928 he was transferred from Yuma to the Yakima project in Washington as superintendent.

Since 1931 Mr. Preston has been senior engineer in charge of Colorado investigations, a number of which have been under way. These investigations include the preliminary surveys in connection with the Colorado-Big Thompson project.

In 1926 and 1927, and again in 1927 and 1928, Mr. Preston served on Government boards studying problems of a number of Federal and Indian irrigation projects. He is a member of the American Society of Civil Engineers and of the Colorado Society of Engineers.

Repayment Contract Executed

ON JULY 28 a contract was executed with the Northern Colorado Water Conservancy District for repayment of the costs of the Colorado-Big Thompson project, Colorado, which have been allocated to irrigation.

Under the contract the conservancy district must repay the cost of half of all the works involved in the construction of the project, except that its maximum obligation is placed at $25,000,000. The project is estimated to cost $44,000,000 when completed. The other half of the costs are chargeable to power and will be repaid from power revenues.

The district also agreed to pay one-half of the operation and maintenance costs of project works, except that of the strictly power features, such as power plants and transmission lines, and except that the district will wholly maintain certain comparatively small canals.

The district will make its payments in 40 years, with the first 20 annual installments amounting to $450,000, the next 10 to $500,000, and the last 10 to whatever is necessary to pay the remainder of the amount due in 10 equal parts.

Execution of the repayment contract is a necessary step preliminary to construction of this project under special act. The reclamation law requires that the water users of all Federal Reclamation projects shall repay without interest the cost of construction of their irrigation works.

This contract, drafted several weeks ago, was submitted recently to the electorate of the Northern Colorado Water Conservancy District for an expression of their approval or disapproval. The vote was favorable by about 18 to 1. The conservancy district includes both the 615,000 acres of irrigated land, which will receive a supplemental water supply from the Colorado-Big Thompson project, and also the villages, towns, and cities within the area. Part of the repayments will come from a general district tax levy. The contract must be confirmed by the court. The Colorado courts in a friendly test case, already have declared the Conservancy District Act valid and this particular conservancy district properly organized. It is anticipated that validation of the contract in the Colorado courts will be a formality.

The construction of the project works, which will include a 13-mile tunnel under the Continental Divide, the Green Mountain reservoir and power plant on the western slope, five power plant and transmission lines, and storage reservoirs and distribution systems on the eastern slope of the Continental Divide, is expected to get under way shortly.

The repayment contract just executed contains several other important provisions. One is that the district agrees to compensate Grand County over a period of time for tax losses in an amount of $100,000. Grand County, on the western slope, is not within the district.

Under the contract, the United States will operate and maintain the project indefinitely, and the district is required to set up a reserve to aid in making repairs and replacements of project structures. Title to all the works remains in the United States perpetually, and the power revenues accrue to the United States.

The contract also provides that the Rocky Mountain National Park shall have a right to use 3 second-feet of water from the Continental Divide Tunnel and the right to increase this usage in the event more water is needed for culinary or domestic purposes in the park area.

All repayment contracts on Bureau of Reclamation projects contain a clause which provides that the superintendent of operations appointed by the project or irrigation district board shall be approved by the Secretary. This contract contains this provision with the added clause that the compensation to be paid to the superintendent also shall meet the Secretary's approval.

Yakima To Have New Warehouse To Store Sugar

CONSTRUCTION of a storage warehouse with a capacity of 200,000 bags of sugar at an estimated cost of $50,000 has been announced by the Utah-Idaho Sugar Co. The structure, to be built adjacent to the company's plant, will be required to store the sugar from the increased season's production of sugar beets in the Yakima Valley.

Concrete Manual

IN the September issue of The Reclamation Era there appeared a notice of the availability of the technical book Concrete Manual, the price being stated as $1.00 per copy, postage free in the United States, Canada, and Mexico; and $1.25, including foreign postage elsewhere.

The price to foreign countries should have been stated as $1.12 instead of $1.25. Orders are payable to the Bureau of Reclamation at Washington, D. C., or Denver, Colo.

Reclamation Organization Activities

Reno Conference

WESTERN irrigation interests will be pleased to learn that the Honorable Harold L. Ickes, Secretary of the Interior, is planning a trip this fall which will permit visits to a number of reclamation developments. After his appearance on the program of the National Reclamation Association at Reno, Nev., October 13, his plans include a visit to Boulder Dam.

Boulder City Conference

WHILE at Boulder City the Secretary will attend a conference of Bureau personnel, which is being called to discuss various problems involved in Bureau activities. Commissioner of Reclamation John C. Page will accompany the Secretary on portions of this trip.

Others in attendance will be J. Kennard Cheadle, Chief Counsel; Miss Mary E. Gallagher, Secretary to the Commissioner; George O. Sanford, Supervisor of Operation and Maintenance; William F. Kubach, Chief Accountant; and William E. Warne, Director of Information, from Washington; Philip D. Dickinson, Assistant Director of Information, and Bernard D. Glaha, Chief Photographer, from Sacramento; Sol E. Hutton, Assistant Director of Information from Coulee Dam, Washington; Chief Engineer Walter from Denver, and members of his staff; such supervising engineers, construction engineers, superintendents, and district counsel as may be spared from their headquarters, and others by special authorization—approximately 60 in all.

J. L. Savage Abroad

J. L. SAVAGE, Chief Designing Engineer, has applied for a period of leave in order to furnish consulting service to the Government of New South Wales which requires his presence in London, England, for several weeks. Mr. Savage stopped at the Washington office en route to New York, from which port he sailed on September 28.

PERSONNEL CHANGES

THE following recent personnel changes in the Bureau of Reclamation have been authorized by the Secretary of the Interior:

Appointments

Washington Office:

Howard R. Stinson, attorney (Assistant Chief Counsel), Legal Division, by transfer from Office of the Solicitor.

Denver Office:

Floyd H. Elsom, associate engineer, by transfer from War Department.

Fred Locher, junior engineer, formerly in War Department.

George W. Chynoweth, Jr., junior engineer (electrical), formerly junior radio engineer, National Park Service.

Boulder Canyon:

James H. Harvey, associate engineer (electrical).

Green River-Bear River investigations:

Elton K. Thomas, junior engineer, at Salt Lake City, Utah, from junior civil engineer, Department of Agriculture.

Transfers

To Denver:

James D. Church, Jr., assistant engineer, from Boulder Canyon project (All-American Canal).

Cecil O. Dale, assistant engineer, from Parker Dam.

To Colorado River Basin investigations:

Lester J. Brown, assistant engineer, from Caballo Dam, Rio Grande project.

To Central Valley, Kennett Division:

Clarence W. Jackson, engineer, from All-American Canal project.

William J. McCrystle, assistant engineer, from Friant division.

Wilbur W. Weed, chief landscape gardener, to Shasta dam site from Boulder Canyon project.

Upper Snake River project:

Julius S. Conrad, junior engineer, from Vale project.

Separations

Denver Office:

Frank C. Merriell, engineer, to accept position with Colorado River Water Conservation District at Grand Junction, Colo.

Edward F. Wilsey, assistant engineer, to accept associate professorship at Ohio University, Athens, Ohio.

Salt River project:

Frederick M. Shaw, associate engineer, to enter employment under the State of Arizona.

Riverton, Bull Lake Dam:

Arthur P. Smyth, resident engineer, to accept private employment in Haiti.

Kendrick project:

Albert M. Zuill, associate engineer, due t completion of work.

Reallocation

Washington Office:

Philip A. Rosendorn, transferred from th position of assistant engineer to that of chie draftsman in the Engineering Division, vic Edward A. Dacey, retired.

Death

WILLIAM N. ALLISON, junior engineer, Co lumbia Basin project, died at Amarillo, Tex on July 29 while on annual leave.

Progress of Investigations of Projects

(Continued from page 213)

interested parties. Discussions were hel with local interests on both the Angostura an Rapid Valley projects relative to furthe work on these projects.

Utah-Idaho-Wyoming, Bear River sur vey.—The delineation of data on the aeria mosaic sheets was continued. Topographi surveys and geological examinations wer carried out at reservoir and dam sites. Wa ter supply studies were in progress.

Utah, Gooseberry investigations.—Wate supply studies, the compilation of data, an the preparation of draft of report were i progress during the month.

Utah, Weber River investigations.—Wate supply studies, stream measurements, lan classification, and a reconnaissance of th watershed were continued during the mont and surveys of reservoir sites were initiated

Colorado River investigations.—Work con tinued on land classification in the Gree River Basin, as well as surveys of canal lines dams, and reservoir sites. Test exploration and geological investigations of the dam site were also carried on. Report on the Mon tezuma project is in preparation.

Minidoka Community Development

PLANS for the new $118,000 courthouse a Burley, headquarters for the Minidoka project have been approved and the contract for ex cavation of the basement has been awarded A grant of about $40,000 for the improvemen of the Burley airport and erection of a hanga is announced. At Rupert also funds hav been provided for improvement of severa public parks.

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ADMINISTRATIVE ORGANIZATION OF THE BUREAU OF RECLAMATION

HAROLD L. ICKES, SECRETARY OF THE INTERIOR

F. K. BURLEW, FIRST ASSISTANT SECRETARY and Budget Officer (in charge of reclamation)

John C. Page, Commissioner — **Roy B. Williams,** Assistant Commissioner

J. Kennard Cheadle, Chief Counsel and Assistant to Commissioner; Miss Mae A. Schnurr, Chief, Division of Public Relations; George O. Sanford, General Supervisor of Operation and Maintenance; D. S. Stuver, Asst. Gen. Supr.; Wesley R. Nelson, Chief, Engineering Division; P. I. Taylor, Assistant Chief; A. R. Golzé, Supervising Engineer, C. C. C. Division; W. E. Warne, Director of Information; William F. Kubach, Chief Accountant; Charles N. McCulloch, Chief Clerk; Jesse W. Myer, Chief, Mails and Files Division; Miss Mary E. Gallagher, Secretary to the Commissioner

Denver, Colo., United States Customhouse

R. F. Walter, Chief Eng.; S. O. Harper, Asst. Chief Eng.; J. L. Savage, Chief Designing Eng.; W. H. Nalder, Asst. Chief Designing Eng.; L. N. McClellan, Chief Electrical Eng.; Kenneth B. Keener, Senior Engineer, Dams; H. R. McBirney, Senior Engineer, Canals; E. B. Debler, Hydraulic Eng.; I. E. Houk, Senior Engineer, Technical Studies; Spencer L. Baird, District Counsel; L. R. Smith, Chief Clerk; Vern H. Thompson, Purchasing Agent; C. A. Lyman and Henry W. Johnson, Examiners of Accounts; L. S. Davis, Engineer, C. C. C. Division

Projects under construction or operated in whole or in part by the Bureau of Reclamation

Project	Office	Official in charge		Chief clerk	District counsel	
		Name	Title		Name	Address
All-American Canal [1]	Yuma, Ariz.	Leo J. Foster	Constr. engr.	J. C. Thrailkill	R. J. Coffey	Los Angeles, Calif.
Belle Fourche	Newell, S. Dak.	F. C. Youngblutt	Superintendent	J. P. Siebeneicher	W. J. Burke	Billings, Mont.
Boise	Boise, Idaho	R. J. Newell	Constr. engr.	Robert B. Smith	B. E. Stoutemyer	Portland, Oreg.
Boulder Dam and power plant [1]	Boulder City, Nev.	Irving C. Harris	Director of power	Gail H. Baird	R. J. Coffey	Los Angeles, Calif.
Buffalo Rapids	Glendive, Mont.	Paul A. Jones	Constr. engr.	Edwin M. Bean	W. J. Burke	Billings, Mont.
Carlsbad	Carlsbad, N. Mex.	L. E. Foster	Superintendent	E. W. Shepard	H. J. S. Devries	El Paso, Tex.
Central Valley	Sacramento, Calif.	W. R. Young	Supervising engr.	E. R. Mills	R. J. Coffey	Los Angeles, Calif.
Kennett Div. (Shasta Dam)	Redding, Calif.	Ralph Lowry	Constr. engr.		R. J. Coffey	Los Angeles, Calif.
Colorado-Big Thompson	Denver, Colo.	Porter J. Preston	Supervising engr.	C. M. Voyen	J. R. Alexander	Salt Lake City, Utah
Colorado River	Austin, Tex.	Ernest A. Moritz	Constr. engr.	William F. Sha	H. J. S. Devries	El Paso, Tex.
Columbia Basin	Coulee Dam, Wash.	F. A. Banks	Constr. engr.	C. B. Funk	B. E. Stoutemyer	Portland, Oreg.
Deschutes	Bend, Oreg.	C. C. Fisher	Engineer	James A. Dolphin	B. E. Stoutemyer	Portland, Oreg.
Fruit Grower's Dam	Montrose, Colo.		Constr. engr.	Ewalt P. Anderson	J. R. Alexander	Salt Lake City, Utah
Gila	Yuma, Ariz.	Leo J. Foster	Constr. engr.	J. C. Thrailkill	R. J. Coffey	Los Angeles, Calif.
Grand Valley	Grand Junction, Colo.	W. J. Chiesman	Superintendent	Emil T. Ficenec	J. R. Alexander	Salt Lake City, Utah
Humboldt	Lovelock, Nev.	Stanley R. Marean	Superintendent	George B. Snow	J. R. Alexander	Salt Lake City, Utah
Kendrick	Casper, Wyo.	H. W. Bashore	Constr. engr.	George W. Lyle	W. J. Burke	Billings, Mont.
Klamath	Klamath Falls, Oreg.	B. E. Hayden	Superintendent	W. I. Tingley	B. E. Stoutemyer	Portland, Oreg.
Milk River	Malta, Mont.	H. H. Johnson	Superintendent	E. E. Chabot	W. J. Burke	Billings, Mont.
Fresno Dam	Havre, Mont.	H. V. Hubbell	Constr. engr.	E. E. Chabot	W. J. Burke	Billings, Mont.
Minidoka	Burley, Idaho	Dana Templin	Superintendent	G. C. Patterson	B. E. Stoutemyer	Portland, Oreg.
Moon Lake	Duchesne, Utah	E. J. Westerhouse	Constr. engr.	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah
North Platte	Guernsey, Wyo.	C. F. Gleason	Supt. of power	A. T. Stimpfig	W. J. Burke	Billings, Mont.
Orland	Orland, Calif.	D. L. Carmody	Superintendent	W. D. Funk	R. J. Coffey	Los Angeles, Calif.
Owyhee	Boise, Idaho	R. J. Newell	Constr. engr.	Robert B. Smith	B. E. Stoutemyer	Portland, Oreg.
Parker Dam	Parker Dam, Calif.	Howard P. Bunger	Constr. engr.		R. J. Coffey	Los Angeles, Calif.
Pine River	Bayfield, Colo.	Charles A. Burns	Constr. engr.	Frank F. Cawn	J. R. Alexander	Salt Lake City, Utah
Provo River	Provo, Utah	E. O. Larson	Constr. engr.	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah
Rio Grande	El Paso, Tex.	L. R. Fiock	Superintendent	H. H. Berryhill	H. J. S. Devries	El Paso, Tex.
Riverton	Riverton, Wyo.	H. D. Comstock	Superintendent	C. B. Wentzel	W. J. Burke	Billings, Mont.
Elephant Butte Power Plant	Engle, N. Mex.	Samuel A. McWilliams	Engineer	H. H. Berryhill	H. J. S. Devries	El Paso, Tex.
Salt River	Phoenix, Ariz.	E. C. Koppen	Constr. engr.	Edgar A. Peek	R. J. Coffey	Los Angeles, Calif.
Sanpete	Provo, Utah	E. O. Larson	Constr. engr.	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah
Shoshone	Powell, Wyo.	L. J. Windle	Superintendent [2]	L. J. Windle [2]	W. J. Burke	Billings, Mont.
Heart Mountain division	Cody, Wyo.	Walter F. Kemp	Constr. engr.	L. J. Windle [2]	W. J. Burke	Billings, Mont.
Sun River, Greenfields division	Fairfield, Mont.	A. W. Walker	Superintendent		W. J. Burke	Billings, Mont.
Truckee River Storage	Reno, Nev.	Charles S. Hale	Constr. engr.	George B. Snow	J. R. Alexander	Salt Lake City, Utah
Umatilla (McKay Dam)	Pendleton, Oreg.	C. L. Tice	Reservoir supt.		B. E. Stoutemyer	Portland, Oreg.
Uncompahgre: Repairs to canals	Montrose, Colo.	Denton J. Paul	Constr. engr.	Ewalt P. Anderson	J. R. Alexander	Salt Lake City, Utah
Upper Snake River Storage [3]	Ashton, Idaho	H. A. Parker	Constr. engr.	Emmanuel V. Hillius	B. E. Stoutemyer	Portland, Oreg.
Vale	Vale, Oreg.	C. C. Ketchum	Superintendent		B. E. Stoutemyer	Portland, Oreg.
Yakima	Yakima, Wash.	J. S. Moore	Superintendent	Philo M. Wheeler	B. E. Stoutemyer	Portland, Oreg.
Roza division	Yakima, Wash.	Charles E. Crownover	Constr. engr.	Alex. S. Harker	B. E. Stoutemyer	Portland, Oreg.
Yuma	Yuma, Ariz.	C. B. Elliott	Superintendent	Noble O. Anderson	R. J. Coffey	Los Angeles, Calif.

[1] Boulder Canyon. [2] Acting. [3] Island Park and Grassy Lake Dams.

Projects or divisions of projects of Bureau of Reclamation operated by water users

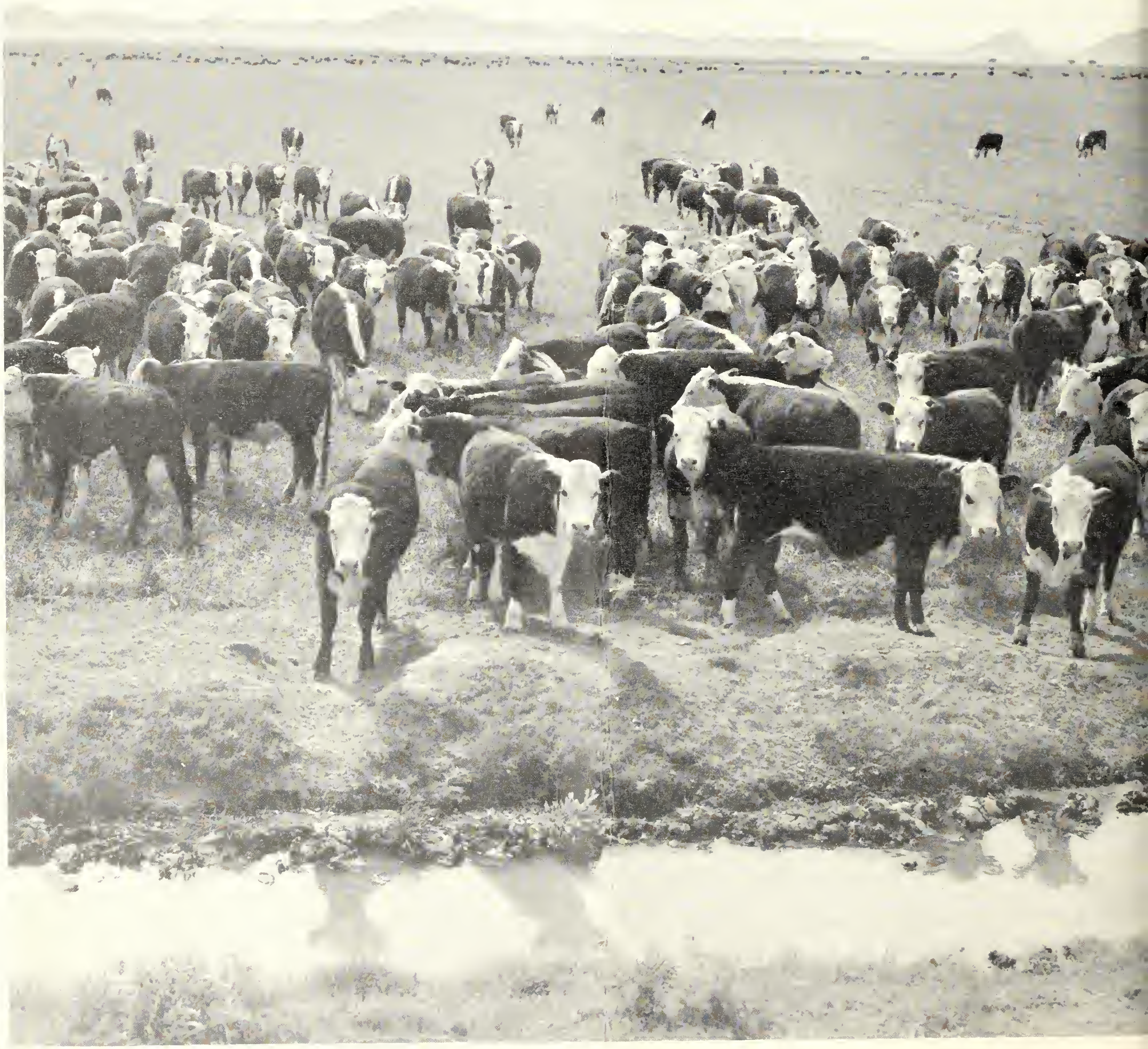
Project	Organization	Office	Operating official		Secretary	
			Name	Title	Name	Address
Baker (Thief Valley division) [1]	Lower Powder River irrigation district	Baker, Oreg.	A. J. Ritter	President	F. A. Phillips	Keating.
Bitter Root [4]	Bitter Root irrigation district	Hamilton, Mont.	N. W. Blindauer	Manager	Elsie H. Wagner	Hamilton
Boise [1]	Board of Control	Boise, Idaho	Wm. H. Tuller	Project manager	L. P. Jensen	Boise
Boise [1]	Black Canyon irrigation district	Notus, Idaho	W. H. Jordan	Superintendent	L. M. Watson	Caldwell
Frenchtown	Frenchtown irrigation district	Frenchtown, Mont.	Edward Donlan	President	Ralph P. Schaffer	Huson.
Grand Valley, Orchard Mesa [3]	Orchard Mesa irrigation district	Grand Jctn., Colo.	C. W. Tharp	Superintendent	C. J. McCormich	Grand Jctn.
Huntley [4]	Huntley irrigation district	Ballatine, Mont.	E. E. Lewis	Manager	H. S. Elliott	Ballatine
Hyrum [3]	South Cache W. U. A.	Wellsville, Utah	B. L. Mendenhall	Superintendent	Harry C. Parker	Logan
Klamath, Langell Valley [1]	Langell Valley irrigation district	Bonanza, Oreg.	Chas. A. Revell	Manager	Chas. A. Revell	Bonanza
Klamath, Horsefly [1]	Horsefly irrigation district	Bonanza, Oreg.	Henry Schmor, Jr.	President	Dorothy Eyers	Bonanza
Lower Yellowstone [4]	Board of Control	Sidney, Mont.	Axel Persson	Manager	Axel Persson	Sidney
Milk River: Chinook division [4]	Alfalfa Valley irrigation district	Chinook, Mont.	A. L. Benton	Vice President	R. H. Clarkson	Chinook.
Minidoka: Gravity [1]	Minidoka irrigation district	Rupert, Idaho	Frank A. Ballard	Manager	O. W. Paul	Rupert.
Pumping [1]	Burley irrigation district	Burley, Idaho	Hugh L. Crawford	Manager	Frank O. Redfield	Burley.
Gooding [1]	Amer. Falls Reserv. Dist. No. 2	Gooding, Idaho	S. T. Baer	Manager	Ida M. Johnson	Gooding
Newlands [3]	Truckee-Carson irrigation district	Fallon, Nev.	W. H. Wallace	Manager	H. W. Emery	Fallon
North Platte: Interstate division [4]	Pathfinder irrigation district	Mitchell, Nebr.	T. W. Parry	Manager	Flora K. Schroeder	Mitchell.
Fort Laramie division [4]	Gering-Fort Laramie irrigation district	Gering, Nebr.	W. O. Fleenor	Superintendent	C. G. Klingman	Gering
Fort Laramie division [4]	Goshen irrigation district	Torrington, Wyo.	Floyd M. Roush	Superintendent	Mary E. Harrach	Torrington
Northport division [4]	Northport irrigation district	Northport, Nebr.	Mark Iddings	Manager	Mabel J. Thompson	Bridgeport
Ogden River	Ogden River, W. U. A.	Ogden, Utah	David A. Scott	Superintendent	Wm. P. Stephens	Ogden, Utah
Okanogan [1]	Okanogan irrigation district	Okanogan, Wash.	Nelson D. Thorp	Manager	Nelson D. Thorp	Okanogan.
Salt Lake Basin (Echo Res.) [3]	Weber River Water Users' Assn.	Ogden, Utah	D. D. Harris	Manager	D. D. Harris	Layton.
Salt River [2]	Salt River Valley W. U. A.	Phoenix, Ariz.	H. J. Lawson	Superintendent	F. C. Henshaw	Phoenix.
Shoshone: Garland division [4]	Shoshone irrigation district	Powell, Wyo.	Paul Nelson	Acting irri. supt.	R. J. Schwendiman	Powell
Frannie division [4]	Deaver irrigation district	Deaver, Wyo.	Floyd Lucas	Manager	Harry Barrows	Deaver.
Strawberry Valley	Strawberry Water Users' Assn.	Payson, Utah	S. W. Grotegut	President	E. G. Breeze	Payson.
Sun River: Fort Shaw division [4]	Fort Shaw irrigation district	Fort Shaw, Mont.	C. L. Bailey	Manager	C. L. Bailey	Fort Shaw.
Greenfields division [4]	Greenfields irrigation district	Fairfield, Mont.	A. W. Walker	Manager	H. P. Wangen	Fairfield.
Umatilla: East division [1]	Hermiston irrigation district	Hermiston, Oreg.	E. D. Martin	Manager	Enos D. Martin	Hermiston.
West division [1]	West Extension irrigation district	Irrigon, Oreg.	A. C. Houghton	Manager	A. C. Houghton	Irrigon
Uncompahgre [3]	Uncompahgre Valley W. U. A.	Montrose, Colo.	Jesse R. Thompson	Manager	H. D. Galloway	Montrose
Yakima, Kittitas division [1]	Kittitas reclamation district	Ellensburg, Wash.	A. W. Russell	Manager	G. L. Sterling	Ellensburg.

[1] B. E. Stoutemyer, district counsel, Portland, Oreg.
[2] R. J. Coffey, district counsel, Los Angeles, Calif.
[3] J. R. Alexander, district counsel, Salt Lake City, Utah.
[4] W. J. Burke, district counsel, Billings, Mont.

Important investigations in progress

Project	Office	In charge of	Title
Colorado River Basin, sec. 15	Denver, Colo.	E. B. Debler and P. J. Preston	Senior engineers.
Boise-Weiser-Payette	Boise, Idaho	Lester C. Walker	Engineer
Kenton and Fort Supply	Denver, Colo.	A. N. Thompson	Engineer
Black Hills	Denver, Colo.	Denver, Office	
Eastern Slope (Colo.)	Denver, Colo.	A. N. Thompson	Engineer
Salt Lake Basin	Provo, Utah	E. O. Larson	Construction engineer
Marias	Shelby, Mont.	Fred H. Nichols	Associate engineer.
Bear River Surveys	Salt Lake City, Utah	E. G. Nielsen	Associate engineer

Issued monthly by the Bureau of Reclamation, Department of the Interior, as approved by the Director of the Budget. SALLIE A. B. COE, *Editor*.



FEEDING BEEF CATTLE ON A FEDERAL RECLAMATION PROJECT

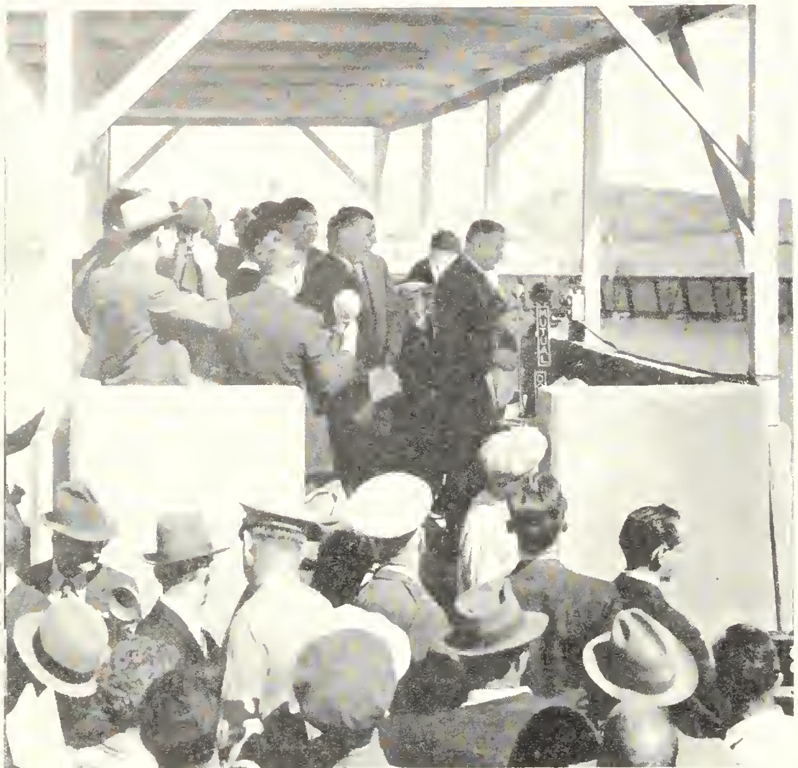
FRONT COVER: ORANGE GROVE WITH BORDER PLANTI
OF TAMARISK TREES, SALT RIVER PROJECT, ARIZO

THE RECLAMATION ERA

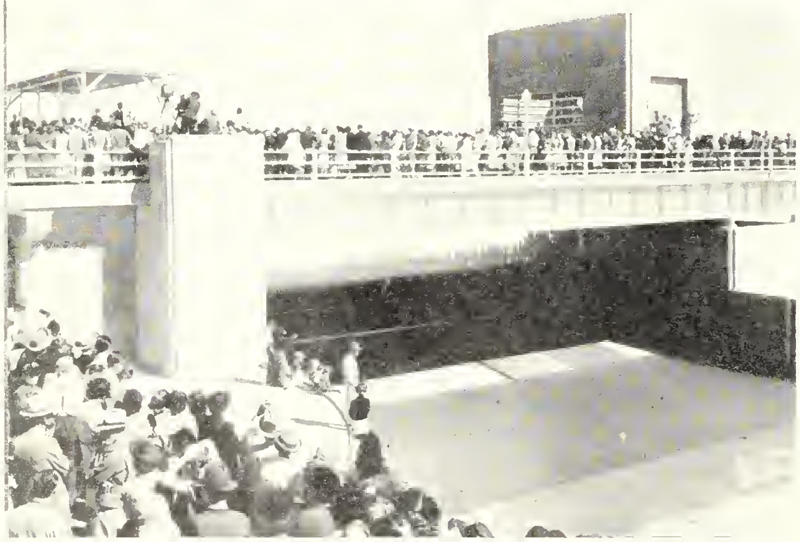
NOVEMBER 1938

TURKEYS READY FOR THANKSGIVING MARKET

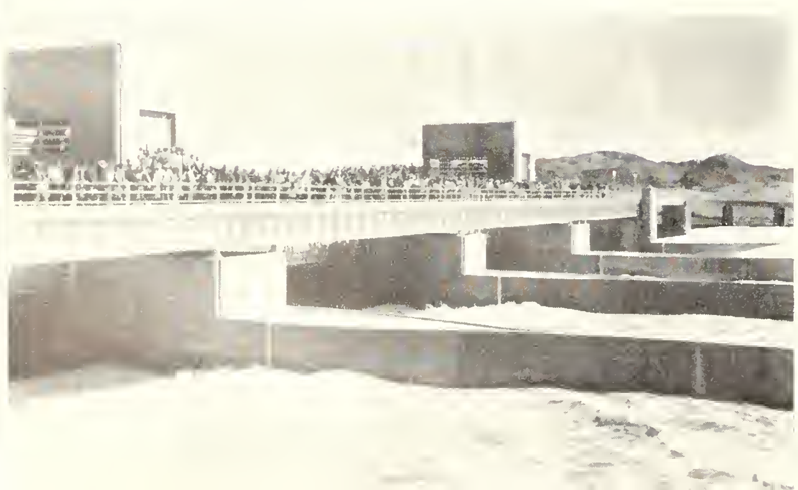
DEDICATION OF IMPERIAL DAM, ALL-AMERICAN CANAL



Secretary Ickes starts operation of desilting works



Crowds throng to witness dedication



Thousands watch channels fill with first water to pass headgates

Clarifiers clear water of sil

Clear water enters effluent channe

Diverted at Imperial dam, the Colorado Rive
enters All-American Canal. Twenty miles o
the 80-mile canal are now ready for seasoning

PRICE ONE DOLLAR A YEAR

THE RECLAMATION ERA

VOLUME 28 • NOVEMBER 1938 • NUMBER 11

Water Creates an Empire

By Hon. HAROLD L. ICKES, *Secretary of the Interior*[1]

IT IS a genuine pleasure for me to be with you here today as we turn the first water into this great All-American Canal. Doubtless, among you are some who came into the Imperial Valley in 1901 and 1902 and lived in tents while you prepared homesteads in the blistering desert for the first irrigation. You have lived to see this section of the Southwest mature. You have seen the treacherous Colorado River controlled by Boulder Dam, and today the dream of an All-American Canal, with a never-failing water supply, is nearing completion. For you this day must be one of great satisfaction. You have built your homes under conditions which would have defeated less persistent men, and you have seen your valley grow to one of importance to the whole of the United States.

There are among you also several of those determined leaders who carried the fight for control of the Colorado River from the Imperial Valley to Washington and thence throughout the country until your point was won. Today you must entertain a feeling of great pride in a fine achievement.

As I drove through this wonderful valley this morning and as I passed along the great canal I thought of the changes which have come to pass since that small band of Spanish explorers under de Alarcón first laboriously struggled to this point on the Colorado River 399 years ago in search of golden treasures. These intrepid men clung close to the river, for the river meant life to them as it did to the Indians before them, and as it does to you today in this desert land.

Not finding gold ready-minted, or even in gold certificates, the Spaniards turned back into Mexico whence they came. It remained for another race, centuries later, to discover the wealth of this arid region and to reap it for themselves and their country by their toil and labor.

Irrigation Begun in Imperial Valley

I am told that about 70 years ago an attempt was made to work out the colonization and development of land in the Imperial Valley by the diversion of water from the Colorado River through Mexico. This effort was unsuccessful, partly because of the international questions involved. This trial, however, had the effect of drawing attention to the fact that lying here below sea level and even below the level of this great river itself, which runs down a ridge in a bed of its own sediment to the Gulf of California, lay a vast, rich, dry land awaiting only water to make it blossom. Other efforts to irrigate the Imperial Valley were bound to follow. In 1892 the Colorado River Irrigation Co. was formed and made some plans for a diversion through Mexico into the Imperial Valley. This company failed, however, and was succeeded in 1896 by the California Development Co., which later constructed a canal just north of the international boundary. This canal swung some 50 miles south around the sand hills through Mexico and came back into the United States near Calexico.

The irrigation of the Imperial Valley thus was begun. Some of you remember those exciting days. Even a larger number, however, can remember that, in 1905, the Colorado River broke through these hastily made barriers and flowed for 2 years toward the northwest into the Salton Sea, flooding and eroding the farm lands which you had toiled to reclaim. The titanic struggle with the Colorado River which followed is historic. The breach finally was closed, however, and the river turned back into its old channel. The great scar through which the New River now flows is an ever-present reminder of the fury of the Colorado River when uncontrolled.

It was in the determination to prevent a recurrence of that catastrophe that the seed of Boulder Dam was sown. From this has grown one of the greatest projects ever undertaken by the American people, the Boulder Canyon project, which includes the tremendous dam in Black Canyon, standing 726 feet high, and Lake Mead with a capacity sufficient to hold the normal flow of the Colorado River in its entirety for 2 years. From it also has grown the All-American Canal with Imperial Dam and the desilting works here before us.

Yuma Project Started

While private enterprise was building the canal to irrigate the Imperial Valley, construction of the Yuma project across the river in Arizona was begun in 1905 by the Federal Government under the Reclamation Act. Water for this project was taken from the river at Laguna Dam. The first water for irrigation on the Yuma project was delivered in 1910.

Even after surveys and investigations for flood storage reservoirs on the Colorado River were begun and were being carried on, the problems involved were many and serious.

From El Centro to Imperial Dam

SECRETARY ICKES was escorted from El Centro on the morning of Octobr 18, via the All-American Canal, to Imperial Dam, the escort being in charge of the State Highway Patrol of California. En route the Secretary stopped and inspected completed Drop 2, one of the four power drops along the All-American Canal.

The Yuma High School Band, made up of boys and girls in blue and white uniforms, was very colorful. This band opened the ceremony by playing the national anthem and, following the Secretary's address, played other musical numbers.

The Construction Engineer introduced Reclamation Commissioner Page, who in turn introduced Chief Engineer Walter and the Secretary of the Interior.

At the conclusion of the Secretary's address on the subject "Water Creates an Empire," which was broadcast over the Mutual Network, he pressed the button opening the four All-American Canal headgates and the six influent channel gates into the desilting basins. Secretary Ickes then pressed the button starting the 72 Dorr clarifiers in the desilting basins, and proceeded to the inspection of the Imperial Dam and desilting basins, to the Gila headworks, and opened the three radial gates of the Gila headworks structure.

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[1] Address delivered at Imperial Dam as first water was turned into the All-American Canal, October 18, 1938.

To you, the day when the necessary dam could be constructed must have seemed far distant. In the meantime, there continued the ever-present fear of floods, and some $7,000,000 was spent by you on a levee system, lying wholly in Mexico, in an effort to protect the Imperial Valley from a second inundation.

In 1918 the Congress appropriated $15,000 and the Imperial Irrigation District contributed $30,000 to make a complete survey and cost estimate for an All-American Canal. A report made by Messrs. Grunsky, Mead, and Schlecht was submitted July 22, 1919, to the Secretary of the Interior.

It was not until December 21, 1928, however, that the Swing-Johnson bill creating the Boulder Canyon project was approved by the President. The construction of Boulder Dam to control the Colorado River then was assured. It proceeded in due course and with great speed to completion.

But even then all of the preliminaries to the construction of the All-American Canal had not been completed. Under a cooperative contract signed March 26, 1929, between the United States and the Imperial Irrigation District and the Coachella Valley County Water District, further investigations were undertaken by the Bureau of Reclamation. These resulted in the final location of the All-American Canal. The way was finally cleared for construction to start with the execution of the contract of December 1, 1932, between the United States and the Imperial Irrigation District, which was later joined by the Coachella Valley County Water District. By the terms of this contract the districts agreed to repay to the United States the total cost of the canal.

Construction of the All-American Canal was started by the Bureau of Reclamation in the fall of 1934 when funds were allocated by the Public Works Administration. To date approximately $24,000,000 have been expended on this work by the Federal Government. You old-timers can see now that your dream is near its realization. Boulder Dam has forever removed the danger from periodic, major river floods. The great desilting works here at Imperial Dam will effectively remove the silt from the water before it is turned into the canal and thus eliminate the very heavy annual expense that you have sustained for the removal of the silt from your system of ditches.

You have a wonderful valley here along this river, and it is rightly called the Winter Garden of America. Your lettuce comes to the tables of the East at Christmas and New Year, and your cantaloups are being distributed by fast refrigerator express before winter has released its grip on most of the country. Your products are highly specialized and in general are not competitive with those raised elsewhere within our Nation. For example, I am told that of the total of 6,800,000 pounds of dates grown in the United States last year, 6,500,000 pounds came from the Coachella Valley, which will be served by this canal. The remainder of our domestic requirements, some 54,000,000 pounds, was imported from abroad.

It is important that we have such an area as this in our country, and it is important that it be protected and assisted in achieving the safety to which we feel that American communities are entitled. So I share with you the satisfaction that I know you must feel at the completion of this great work.

The water we turn into the canal today will not reach your farms. It will merely mark the beginning of a period of seasoning the canal during which the particles of silt carried in the waters will seal the bottom and sides against seepage and losses. This process will continue for another year. But the time is not far distant when you will see a great stream coursing through the All-American. It will flow across the desert to irrigate your fields, to water your stock, and to serve your cities. Eventually a portion of this will be diverted through a branch canal northward into the Coachella Valley to irrigate new areas and expand your empire. New homes will be made, new opportunities created, new wealth added to enrich our country.

It has been a long time since the Spanish Conquistadores first penetrated this region. Many things have been done since that time but I believe that, among the most important has been the construction of Boulder Dam 350 miles north of you, followed by the completion of this great canal.

National Reclamation Association Report

THE National Reclamation Association in session at Reno, October 11–13, 1938, selected the following officers:

O. S. Warden, Montana, president.

Ora Bundy, Utah, first vice president.

Robert W. Sawyer, Oregon, second vice president.

J. A. Ford, Washington, treasurer.

F. O. Hagie, Washington, D. C., secretary-manager.

Denver, Colo., was chosen for the 1939 convention.

The resolutions adopted, affecting the projects of the Bureau of Reclamation are as follows:

1. That the Federal agencies responsible for the conduct of the C. C. C. camps be requested to modify laws, rules, and regulations in order to permit the employment of the C. C. C. camp personnel in properly sponsored and coordinated noxious weed control projects on an area basis without regard to the ownership of the lands involved, such projects to be conducted in close cooperation with the present Federal, State, or county agency concerned and with private landowners.

2. That this association reaffirms its belief in the absolute need of continuing investigations in cooperation between Federal and State agencies, to include stream gaging, ground-water studies, precipitation observations, snow surveys, topographic mapping, soil surveys, in order that the essential basic information shall be available for the selection, promotion, design, construction, and successful operation of irrigation enterprises, and urges sustained support by Congress and by the State legislatures.

3. Whereas the United States experiment stations on Reclamation projects are doing a work of inestimable value in guiding agricultural practices of project farmers; in developing new and better plant varieties; in investigation of feeding and irrigation practices: Be it

Resolved, That this association commend the work now being done and urge the extension and broadening of such work on the part of the Department of Agriculture.

4. That this association hereby reaffirms its opposition to proposals for the division of the country into regions with corresponding corporate regional authorities and planning agencies, and expresses its preference for the conversion of the National Resources Committee now existing under Executive order into a permanent statutory board for the purpose of enlisting the cooperation of the other existing Federal agencies and the agencies of the States in the coordination of plans for the development of the country's natural resources, the board to reflect in its membership the various areas of the country so that all may receive attention and service.

5. That the policy of the Federal Government in the use of C. C. C. camps in the furtherance of reclamation and the conservation of water resources be approved, and we urge that their efficiency be increased by providing necessary finance and equipment for their operations.

6. That this association reaffirms its resolution adopted at the 1937 convention that in the employment of labor, particularly in the construction of large scale Reclamation projects, all possible steps should be taken by the Federal Government to permit the employment of needy family heads living in the vicinity of such work. While it is recognized as desirable under present conditions of widespread unemployment, that Reclamation projects can and should play as full a part as is reasonably possible in relieving the re

lief rolls by the employment thereon of men on relief, nevertheless the prevention of increase in the number of those on relief should also be sought; and such prevention can, in hundreds of cases, be accomplished by the employment of needy family heads and other unemployed, not yet on relief rolls, and living in the general vicinity of projects under construction. It is the sense of this association that this policy should be pursued, and that its adoption will be helpful not only in preventing the further increase of unemployment in the vicinity of many projects, but in promoting a contented and peaceful labor situation in connection with such construction work.

7. Whereas, limitations imposed upon the expenditure of the $5,000,000 appropriation in the relief act of the 1938 Congress for assisting in Reclamation projects in the Great Plains make this act unworkable, we therefore urge the next session of Congress to reappropriate this sum with these limitations removed; and further, since the unprecedented drought experience continues acute in some areas of the Great Plains causing wholesale migration of dry-land farm families to the irrigated West in search of rehabilitation not now available on irrigation projects in those areas, and since we believe that many thousands of these refugee families could be permanently rehabilitated if feasible irrigation projects were developed, it is the urgent plea of the National Reclamation Association that Congress appropriate funds up to $3,000,000 for engineering and economic surveys by the Reclamation Bureau of projects which seem capable of supporting stable agriculture when and if water can be brought to the land.

8. Whereas, since the retirement of Justices Van Devanter and Sutherland, this region west of the Missouri has had no representative upon the Supreme Court of the United States, and

Whereas, this region comprises a third of the country's continental area and has millions of people and has systems of water and mining law and vast irrigation projects and economic conditions that are unknown by personal contact to eastern lawyers and judges: Therefore be it

Resolved, That the National Reclamation Association hereby respectfully suggests to His Excellency, the President of the United States, that the present vacancy in the membership of the Court be filled by an appointment from this region.

9. Whereas Federal Reclamation projects cannot be constructed until adequate surveys and investigations have been made, and the interests of the Government demand such studies for sound and economically feasible projects; and,

Whereas heretofore wholly inadequate funds have been available to the Bureau of Reclamation for such purpose, and,

Whereas under section 15 of the Boulder Canyon Project Act the Bureau is charged with the responsibility of making a study of a plan of comprehensive development in the Colorado River Basin involving projects and utilization of water in seven reclamation States: Now, therefore be it

Resolved, That this association recommends and urges the appropriation by Congress of sufficient funds to make and complete the surveys and investigations for the purposes heretofore mentioned in this resolution; that such funds should be made available in sufficient amount from year to year in order to make possible an orderly development, without unnecessary delay in all the reclamation States; that full attention should be given to small reservoir storage which is so sorely needed; and that funds should be made available for completion at as early date as possible of the plan of comprehensive development under section 15 of the Boulder Canyon Project Act of the Colorado River Basin.

10. Whereas the sugar section of the United States Department of Agriculture has

(Continued on page 228)

Secretary Ickes and Commissioner Page meet in the West to travel together on an inspection trip in Federal reclamation territory

HOMES OR HAVOC

By JOHN C. PAGE, *Commissioner of Reclamation*[1]

DROUGHT, misuse of soils, and mechanization of agricultural factories in other areas are pouring into the West in second-hand cars thousands upon thousands of unfortunate farm families, who are the victims of a new and tragic problem.

Uprooted from homes by drought and dust storm in the Great Plains; by the wearing out of thin soils in many humid regions; and by a change in farming practices which is leaving many sharecroppers with nothing to do, this new migration is following the paths of its forefathers westward, oblivious of the fact that the frontier has disappeared.

The Department of Agriculture says that more than 50,000 farm families already have left the Great Plains for Idaho, Oregon, Washington, and California. It is estimated that the migration from this area may not be completed until 55,000 additional families have followed the lead.

A count at the California border shows that 221,000 refugees crossed into that State in 2½ years prior to January 1, 1938, and the movement then showed no evidence of stopping.

Thoughtful men and women from coast to coast must consider the consequences. What are these people doing, now that they have "gone West"? Many of them are eking out an existence following the fruit and vegetable harvests around the calendar as they progress from the Imperial Valley northward. They live in camps, or at the side of the road, without sanitary facilities, without proper foods, and with dwindling hope. Many, when they have been in their newly adopted States long enough, apply for relief. Some obtain possession of land and resume farming, although the number doing this is pitifully small. So few have salvaged sufficient funds from the wreckage of their previous lives to be able to finance a new start on a farm. So very few farms are available out here where, in general, land must be irrigated to be productive; where the total farming area is so severely limited by an arid climate.

A solution to the problem thus presented to the United States must be found. A great nation cannot permit the degradation of its people. The Western States and the western communities cannot tolerate long the threat created by tumbleweed towns to their health, their educational systems, their standard of living, and their peace and security.

The solution must be found eventually both in the correction of conditions which are cutting men loose from their land in other areas, and in the provision of opportunities for those who are already adrift to make new homes, to maintain their self-respect, and to weave anew their ties with wholesome communities. The choice, in the long run, must be between homes and havoc.

The time is at hand for all those interested in Federal Reclamation to consider this problem. There seems no hope of increasing materially the opportunities to make farm homes in all this arid and semiarid western third of the United States, except through the construction of irrigation works.

Résumé of Reclamation's Work

Let us scan, briefly, what we are doing in the line of irrigation. The Bureau of Reclamation is irrigating 3,000,000 acres on operating projects. Except for scattered, single farms, for the most part, none of this land is available for resettlement. On a few projects, lands of nonresident owners have been purchased by the Farm Security Administration, subdivided and sold, on easy terms, to those in need. When compared with the size of the problem, this is a small activity, and it must remain so.

On several operating projects there are some holdings of a size which under the law limiting farms on Federal Reclamation projects to 160 acres must be considered excessive, but there are no great tracts available. Subdivision of the excess holdings will furnish some new homes.

The Bureau of Reclamation is constructing about a score of projects which will make water available for irrigation of new and unoccupied areas. Some of these projects have been under construction for several years. Some are comparatively new. Some will make sizable areas available soon, but the largest and most important, the Grand Coulee Dam project, is a long-time undertaking.

In all, the new construction will make available 2,500,000 acres of land for settlement. If all of this land were ready for entry tomorrow, it might take care of 40,000 families. Placement of such a number would be a material help, but it would not solve the problem. Remember, there have been more than 50,000 families forced to leave the Great Plains for the West already, and these are not all who are involved.

It will be two decades before all of this new land has water. A great and complicated irrigation project, involving dams, canals, power plants, and other engineering works, cannot be built in a day.

Some of the structures under way are larger than the Great Pyramid of Cheops, and it took 100,000 men two decades to build that ancient marvel. We do much better now, but even when we break construction records every day, it takes about 8 years to finish Grand Coulee Dam. Then there is the canal system remaining to be built.

Reclamation projects, the largest and best hope of providing permanent homes for the new waves of western migrants, so far as we can anticipate now, cannot solve the problem. In another year or two we will be able to offer an average of about 150,000 acres of new land each year for settlement, a little more in some years and a little less in others, until the whole 2,500,000 acres is built up. These projects will not solve the problem, but they will help materially. They stand today as the shining hope of thousands for a new life and a new chance.

Many of you are familiar with our regulations for the settlement of land. You realize that some modification of procedure must be made to assure that the penniless, though worthy, drought refugee can obtain land on a Reclamation project. This we are attempting to work out with the Farm Security Administration. I feel confident that it can be done without sacrificing any of the advantages to the projects of the selection system we have established and maintained. We ask the cooperation of the West in this endeavor.

Large Additional Areas Possibly Feasible

I have spoken, so far, only of what we are doing. Through expansion of the program what could be done? It is our estimate that in addition to the 2,500,000 acres included in projects now under construction, there are an additional 7,500,000 acres in the West susceptible of irrigation by projects which might possibly be considered feasible; in other words, by projects the cost of which it would be reasonable to assume the settlers could repay in 40 years. The Bureau of Reclamation now has insufficient data to plan these projects. Years of investigations and surveys must precede such a program of construction. Some of them might be started soon, but others must wait.

It is not, however, too early to plan. Under the Boulder Canyon Project Act we have proceeded, although somewhat slowly due to insufficiency of funds, with the investigation of the entire Colorado River watershed. It would be of distinct benefit if we were directed to proceed methodically with the investigation of all other western streams, to determine where, when, and how the avail-

[1] Address delivered at Reno, Nevada, on October 12 before a session of the Seventh Annual Convention of the National Reclamation Association.

able waters best could be used for irrigation. It would be a big job, but a worthy one. It should be undertaken at once. I leave this thought with you.

Report of Repayment Commission

From the broader questions, let us turn, for a minute, to the problems more intimate to Federal Reclamation. This convention will consider the report of the Repayment Commission. I commend it to you as a document carefully prepared by three eminent and earnest western men.

Too often thoughtful investigations result only in a report which collects dust on library shelves. The problems discussed in the report of the Repayment Commission are too vital to permit this report to suffer a similar fate. Serious consideration must be given, for example, to the matter of fixing a more flexible repayment method, to name only one of the topics upon which recommendations were made. It is time that something be done to forestall sporadic general moratoria on construction charges, or the Federal reclamation policy may be permanently weakened.

I cannot urge too strongly that this problem be approached by all with a full realization of what is involved. Federal reclamation is not a system of charity, nor does the Bureau of Reclamation have a guardian's relationship with its projects. Reclamation was adopted as a national policy because it is in the public interest that the West be developed, within its natural limitations, through a series of communities of self-reliant men and women.

This historic policy, in other words, recognizes that it is as important to the Nation to create a prosperous new community as it is to the settler to have an opportunity to bring up his family in a farm home carved by irrigation from the desert.

Reclamation Fund Must be Protected

There must be no attempt to shift the cost of reclamation to the Federal Government, or the Federal reclamation policy will collapse. The Bureau of Reclamation was made custodian of the Reclamation Fund, which by revolving makes new projects possible, and our responsibility to protect that fund is just as great to the Western States, where new projects are needed, as to the Nation as a whole. Similarly, the West has a responsibility to assist us in protecting the fund through supporting the sanctity of repayment contracts. This responsibility on the part of the West is as strong to itself as it is to the Nation. The repayment contract is the foundation of Federal reclamation. It should be strengthened, not weakened. Consider these things.

Recently the Congress, through enactment of the Hayden-O'Mahoney amendment to the 1939 Interior Department appropriation bill, went a long way toward providing for the Reclamation Fund the additional support it needed to offset the dwindling of revenues from the sale of public lands. This was the most important legislation bearing on reclamation in 10 years.

Under the Hayden-O'Mahoney amendment, about $30,000,000 in funds collected as royalties on oil taken from naval petroleum reserves was transferred to the Reclamation Fund, $15,000,000 of it to be used immediately in retiring a loan made to the fund from the General Treasury several years ago. This makes available an additional $15,000,000, roughly, in the Reclamation Fund to finance projects being constructed from the fund. This amendment, in addition, directed that all money repaid by projects constructed with emergency fund allotments or general fund appropriations should go into the Reclamation Fund until such time as the cost of the project is repaid in full. The net power revenues then will go to the General Treasury. Of course, the Boulder Canyon project was excepted, and vested contract rights of water users were protected.

Commissioner Page and party inspecting Columbia Basin soils near Ephrata, Wash. Left to right: W. W. Johnston, Reclamation Economist; W. P. Stapleton, Western Agricultural Development Agent, Northern Pacific Railway; G. C. Finley, Chairman of Reclamation Committee, Yakima Chamber of Commerce; John C. Page, Commissioner; F. O. Hagie, Secretary of National Reclamation Association; F. A. Banks, Construction Engineer, Columbia Basin project; John W. Haw, Director, Department of Agriculture, Northern Pacific Railway

This latter provision assures the Reclamation Fund of additional accretions in future years, when repayments begin on projects financed from Public Works Administration and Emergency Relief allotments and from General Fund appropriations. No large amount will accrue in the near future. Projects so financed and now repaying are small. When Grand Coulee Dam, the Central Valley project and others begin their repayments, funds from these sources will amount to several millions of dollars a year. It is reasonable to believe that over a period of 40 years or a little more, an amount in excess of $350,000,000 will be received into the Reclamation Fund through the operation of the Hayden-O'Mahoney amendment.

The additional funds in sight for the next few years, however, cannot finance in full the projects now under construction. If construction approaches the scale of the past few years, there must of necessity be appropriations from the General Treasury. The time is not foreseeable when, even with the advantage of the Hayden-O'Mahoney amendment, the Reclamation Fund will be able to finance what is now considered an adequate reclamation construction program.

I want to take cognizance of one other development during the year which I feel to be of major importance. For the first time we have undertaken the construction of a project from which full repayment is not expected. I refer to the Buffalo Rapids project in Montana. We are just starting another of the same class, the Tucumcari project in New Mexico.

Reclamation and Relief Projects

These projects are not considered Reclamation projects, but are considered and are in fact a combination of relief and reclamation. In each instance, the full amount which feasibly could be repaid by the project water users is set up separately to be covered by repayment contracts. In other words, settlers on these two projects will be expected to repay, proportionately, dollar for dollar as much as the settlers on true reclamation projects, and in the same time and on the same terms. They will not repay the full amount of the project cost however. Instead, a portion of the cost, that which could not feasibly be repaid by the water users, and which is properly work relief, is nonreimbursable. Relief labor is being used in the construction.

The amount which is to be repaid was determined by taking the figure in our reports on these projects for the maximum charge which the lands could stand, and saying: "This is what they must repay." Except for the relief contributions, these projects could not have been built. It seems proper to combine relief and reclamation, where conditions in any given community warrant the relief expenditures, and where there is a potential project which can be constructed with the aid of the relief contribution. Something substantial and wealth-producing thus is obtained from the relief expenditure.

Such projects must be scrutinized very carefully, however, to make sure that the lands are good, that they can be made productive through irrigation, and that the necessary water is available. This was done on the projects named. They passed all of these tests. I am not fearful that the construction of such projects will break down the reclamation program, so long as they are understood, and so long as the water users on them shoulder the load of feasible repayments in the same manner as true reclama

(*Continued on page 228*)

Building a Playground at Boulder Dam

By ARNO B. CAMMERER, *Director, National Park Service*[1]

An air view of Boulder Dam and the surrounding Boulder Dam recreational area

Reconstructed Lost City Indian houses at the Overton Museum

THE great Boulder Dam in Black Canyon, Nev., planned originally to provide power, irrigation, and flood control, has now added recreation as a fine bonus for traveling America.

Here, in an arid country of dry, somber, strange mountains, deserts and canyons, the dam has backed up the water of the Colorado River to form brilliant blue Lake Mead, which has become the center of a potentially great recreation region.

Under an inter-bureau agreement, the Bureau of Reclamation which built the dam, has jurisdiction over it and over Boulder City, while the National Park Service supervises all recreational activities in the area. The Service's administration building is fittingly located at the junction of Park Street and Park Place.

Boulder Dam Recreational Area, as this new playground is called, is still in its early stages of development, but more and more of the hundreds of thousands who come to see the dam are remaining to go swimming in the lake, boating on it, and flying above it. The area joins Grand Canyon National Monument on the east and is situated along the course of the Colorado River in northwestern Arizona and southeastern Nevada, extending as far south as the old mining town of Searchlight, Nev. One arm reaches northward to Overton, Nev., and includes the lower basin of the Virgin River.

It is not being considered as a national park but as a development for the use of extensive recreational and educational facilities around a monumental reclamation reservoir in an area of great scientific and scenic interest. However, the man-made recreation developments will not be allowed to detract from the natural beauty and character of the rugged area, large parts of which have been seen by few men.

Reached by motor, train, or airplane, Lake Mead has also greeted a few particularly adventurous visitors who arrive by boat, having made their hazardous way through the rapids of the Grand Canyon of the muddy Colorado into the clear water of the lake.

The three centers of recreational development are Hemenway Wash at the west end of the lake 8 miles from Boulder City, Pierce's Ferry at the eastern end of the lake, and Overton on the Virgin River arm.

The National Park Service has received fine cooperation from the Civilian Conservation Corps in its development program. Enrollees in camps assigned to the area under Park Service supervision have built sandy

[1] All illustrations furnished through courtesy of National Park Service.

beaches at Hemenway Wash and Pierce's Ferry and will start another at Overton shortly. They have provided an excellent landing field at Boulder City for airplanes that take visitors on remarkable scenic flights; built bathhouses and floating boat docks; and are now working on trap shooting fields, and foot and bridle paths leading into areas of unusual rock formations and fascinating desert plants and flowers. They are also participating in the archeological work which has unearthed treasures of prehistoric Indians who once lived on land now, or soon to be, covered by the lake, and the bones and remains of ancient ground sloths found in the remarkable Rampart Cave in the lower reaches of the Grand Canyon.

The level of Lake Mead is still rising, so CCC enrollees must constantly move their beach at Hemenway and replenish it with sand, as today's waters lap up yesterday's shore line. When the constant level is reached a really fine beach is planned, with green grass and trees and flowers making it a true oasis in a stark land. Anyone who doubts that this miracle can be accomplished need only glance at the well-kept green lawns,

Swimming float being launched just off shore at Hemenway Wash beach area

Boulder City airport on occasion of TWA schedules April 3, 1938, when an impromptu rodeo was staged. Work of extending and surfacing the runways was done by CCC forces

Hemenway Wash beach area, showing evidence of heavy use during spring, summer, and fall months

Lower reaches of the Grand Canyon of the Colorado River from the head of navigation on Lake Mead

Above: One of many strange and impressive red sandstone formations in the aptly named Valley of Fire region of the Boulder Dam recreational area, Nevada
Below: Lost Basin and the Grand Wash Cliffs

trees, and shrubs of Boulder City, a city which did not exist a few years ago. Lake Mead supplies all the necessary water to keep greenery green and make it flourish, even in the desert.

There are a variety of boat trips to be made on the lake. The shortest, and one of the most popular, is a trip from Hemenway to the convex, upper face of the dam, and the longest and most spectacular is an all-day trip from Hemenway across the full 115 miles of the lake, past the Grand Wash Cliffs, and on up into the narrow, jagged, fantastic lower reaches of the Grand Canyon of the Colorado. Lucky passengers on the boat trips may see the wild burros fighting on the lake shores—descendants of the burros that copper miners once used in this region. Today they are truly wild, one white one in particular, and very generous with their public fights. Rarer are the few remaining mountain sheep, occasionally glimpsed.

Sightseeing trips in amphibian planes which take off and land on the lake are also available. They circle the white dam, seen as in miniature far below, and fly over the blue-green lake, revealing its narrow stretches through canyons between high cliffs and its wide, placid basins.

A new form of sport recently introduced in the Boulder Dam area is yachting and sail-boating. "Pioneers" in trim yachting vessels find the prevailing winds ideal and prophesy a great yachting future for this lake in the desert. Fishing is excellent with large mouth bass being taken by many sportsmen and the lake is being stocked for the future.

Cooperating wholeheartedly and enthusiastically with the National Park Service in this long-range development program is the area's concessionaire, the Grand Canyon-Boulder Dam Tours, Inc., an organization made up of all the early day operators in the area. This corporation has a comfortable and attractive hotel in Boulder City, a tent camp at Pierce's Ferry, and provides the boat, plane, and taxi service of the area.

Louis C. Hill Dies

AS we go to press, notice has been received in the Washington Office of the sudden death in Los Angeles, on November 6, of Louis C. Hill, Consulting Engineer at Large for the Department of the Interior.

A more detailed statement concerning Mr. Hill's life and official connections will be carried in the December issue of the "Era".

Yakima Opposes Subsidies

THE board of directors of the Yakima Chamber of Commerce at a meeting on September 14 adopted a resolution opposing the policy of subsidizing Federal Reclamation projects, and expressed confidence in the soundness and success of the repayment plan as justified by past experience.

Departmental Committee on Water Resources

UNDER date of September 30, First Assistant Secretary Burlew approved the formation of a permanent committee in Washington to be known as the Departmental Committee on Water Resources, with the following personnel:

N. C. Grover, Chief Hydraulic Engineer, Geological Survey, chairman.

E. F. Preece, Assistant Chief Engineer, National Park Service.

Clay H. Southworth, Assistant to the Director of Irrigation, Office of Indian Affairs.

J. Q. Peterson, Scientist, Division of Grazing.

Wesley R. Nelson, Chief, Division of Engineering, Bureau of Reclamation.

F. M. Shore, Assistant to the Chief of the Economics and Statistics Branch, Bureau of Mines.

The function of the committee is to act as contact agency with the Water Resources Committee and keep the various offices and Bureaus in the department acquainted with the activities of the main committee.

Dams Under Construction

Percent of Completion August 31, 1938

State	Project	Dam	Completion
			Percent
Ariz.	Salt River	Bartlett	78
Ariz.-Calif.	All-American	Imperial	100
	Parker	Parker	98
Calif.	Central Valley	Shasta	1
Colo.	Colo.-Big Thompson	Green Mountain	-------
		Granby[1]	-------
Do.	Pine River	Vallecito	10
	Fruit Grower's	Fruit Grower's	50
Idaho	Boise	Twin Springs[1]	-------
	Upper Snake	Island Park	82
		Grassy Lake	31
Mont.	Milk River	Fresno	46
Nev.	Truckee Storage	Boca	44
N. Mex.-Tex.	Rio Grande	Caballo	98
Oregon	Deschutes	Wikiup	-------
Tex.	Colorado River	Marshall Ford	66
Utah	Provo River	Deer Creek	20
Wash.	Columbia Basin	Grand Coulee	33
	Yakima	Roza Diversion[2]	-------
Wyo.	Kendrick	Seminoe	80
	Riverton	Bull Lake	97

[1] Specifications not yet issued.
[2] Contract just awarded.

The Joshua Tree, strange and beautiful desert growth

Bathers on shore of Lake Mead

F. E. Weymouth Honored

IN recognition of distinguished engineering services, particularly in connection with the building of the 392-mile Metropolitan Aqueduct, Frank E. Weymouth, general manager and chief engineer of the Metropolitan Water District, and formerly Chief Engineer of the Bureau of Reclamation, has been elected an honorary member of the American Society of Civil Engineers.

At present there are only 25 living men who have been elected to honorary membership in this society, which was founded in 1852 and is the oldest civil engineering group in the United States.

Mr. Weymouth has been chief engineer of the Metropolitan Water District since 1929, and has been in charge of the building of the aqueduct which is now nearing completion.—*Southwest Builder and Contractor.*

UNI
DEPARTMEN

HAROLD L
E. K. BURLEW, FI
ADMINISTRA

DIVISION OF INFORMATION
MICHAEL STRAUS DIRECTOR

BUREAU
JOHN C.
ROY B. WILLIAM
2 PROFESS

INFORMATION DIVISION
W E WARNE, DIRECTOR

Prepares and distributes informational and educational material, supervises preparation and maintenance of photographic and other visual records of the Bureau's work handles press contacts and miscellaneous inquiries, prepares reports, performs general editorial duties.

1 SUBPROFESSIONAL AND 5 CLERICAL EMPLOYEES

*** CCC DIVISION**
A R GOLZÉ, CHIEF

Directs the activities of camps allocated to the Bureau, recommends the assignment of CCC funds and personnel to Reclamation projects, maintains records and charts on safety and job training activities, prepares reports for the Department and Director, CCC, coordinates CCC work with regular Reclamation activities.

2 PROFESSIONAL 1 SUBPROFESSIONAL AND 1 CLERICAL EMPLOYEES

* Under general supervision of Robert Fechner, Director, Civilian Conservation Corps

ACCOUNTING DIVISION
W. F. KUBACH, CHIEF ACCOUNTANT

Conducts accounting and financial work of the Bureau, including standardization and coordination of accounting in all field offices, designs accounting systems, maintains control accounts in the Washington Office

26 CLERICAL EMPLOYEES (INCLUDES 2 CCC EMPLOYEES)

ENGINEERING DIVISIO
WESLEY R NELSON, CHI
P I. TAYLOR, ASSISTANT CHI

Reviews bids on all major contrac prepares reports of investigation a construction projects for Federal officia agencies and committees, reviews a recommends action to Land Office applications for oil leases, mineral entri power projects and rights of way, prepar withdrawal and restoration orders public lands, reviews field reports investigations, prepares statistical tabl charts, maps, and drawings of misc ellaneous types, maintains an engineeri library

7 PROFESSIONAL 4 SUBPROFESSI AND 5 CLERICAL EMPLOYEES

FIELD INFORMATION OFFICES

CCC CAMPS

PROJECT	CAMP
BELLE FOURCHE	BR.2
BOISE	BR.74 BR.73
CARLSBAD	BR.3 BR.82
CENTRAL VALLEY	BR.84 BR.85
DESCHUTES	BR.75 BR.76 BR.77
GRAND VALLEY	BR.22 BR.59
HUNTLEY	BR.57
KENDRICK	BR.79
KLAMATH	BR.41
LOWER YELLOWSTONE	BR.30
MILK RIVER	* BR.32, BR.69
MINIDOKA	BR.27, BR.56
MOON LAKE	BR.11
NEWLANDS	BR.34 BR.35
NORTH PLATTE	BR 1, BR 53, BR.83
ORLAND	BR.78
OWYHEE	BR.42, BR.43
PROVO RIVER	BR.64
RIO GRANDE	BR.4 BR.8 BR.39, BR.54
SHOSHONE	BR.7, BR.72, BR.87
SUN RIVER	* BR.33, BR.80
UNCOMPAHGRE	BR.23, BR.71
VALE	BR.45
YAKIMA	BR.58 BR.66
YUMA	** BR.13, BR.74

* SUMMER CAMPS
** WINTER CAMPS

400 EMPLOYEES
8 800 CCC ENROLLEES

OFFICE OF
R. F. W
S. O. HARPER
J. L. SAVAGE

Directs surveys and designs, plans and sp on construction projec handles the purchasing

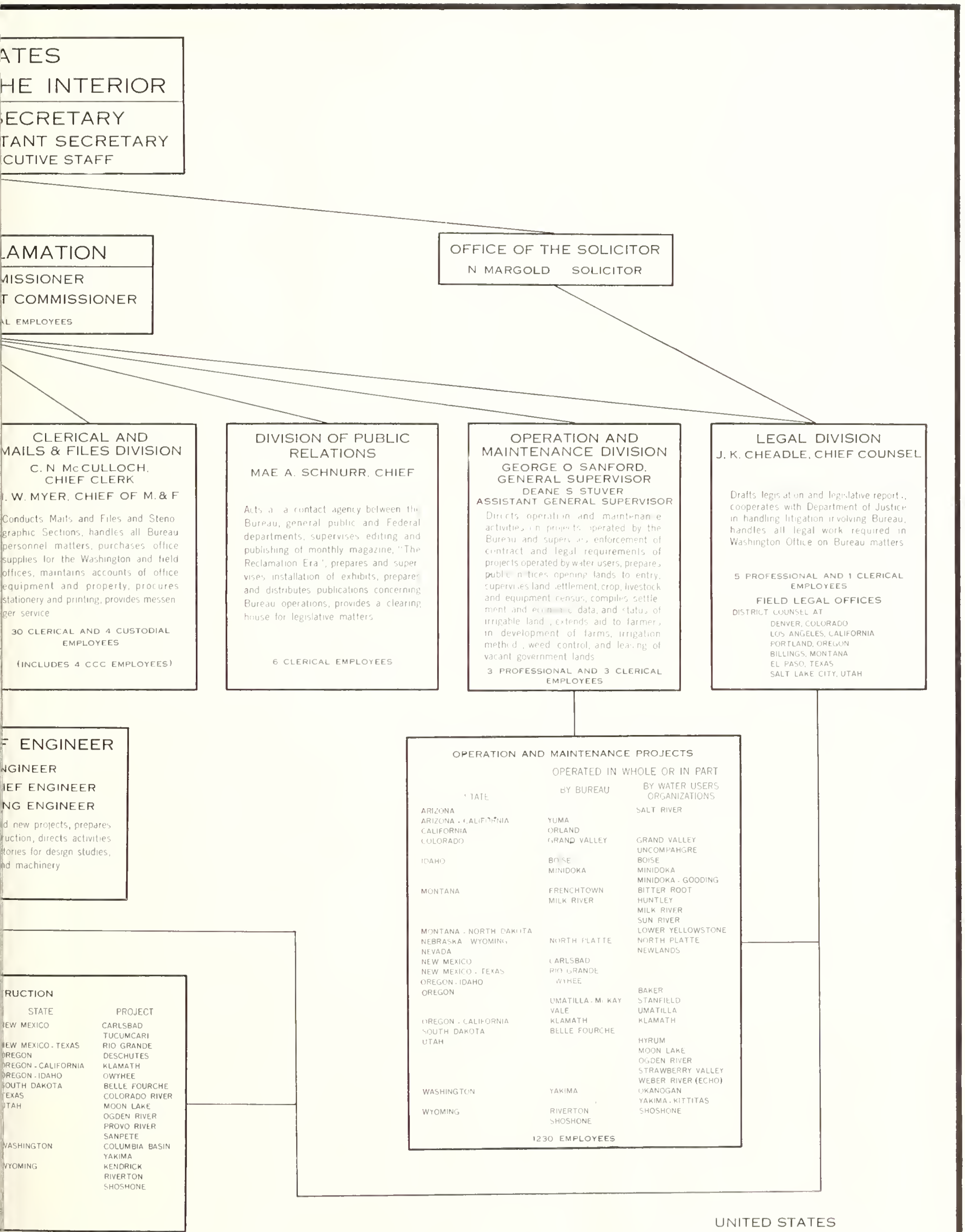
PROJE

STATE	PR
ARIZONA	GILA
	SALT RIVER
ARIZONA - CALIFORNIA	ALL - AMERICA
ARIZ. - CALIF. - NEV.	BOULDER CA
CALIFORNIA	CENTRAL VAL
COLORADO	COLORADO - 8
	FRUIT GROW
	GRAND VALL
	PINE RIVER
	UNCOMPAHGR
IDAHO	BOISE
	MINIDOKA
IDAHO - WYOMING	UPPER SNAK
MONTANA	BUFFALO RA
	MILK RIVER
	SUN RIVER
NEBRASKA - WYOMING	NORTH PLAT
NEVADA - CALIFORNIA	TRUCKEE RIV

SEPT 26, 1938
Approval recommended
John C. Page
COMMISSIONER

APPROVED SEPT. 30, 1938

Sgd E K Burlew
ACTING SECRETARY OF THE INTERIOR



UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

ORGANIZATION CHART

WASHINGTON OFFICE

NO. 38-368
SEPTEMBER 1938

National Reclamation Association Report

(*Continued from page 219*)

recently made tentative acreage allotments for 1939 to the various sugar-beet-producing sections of the United States and

Whereas in many districts such allotment is less than the 1938 planting by 25 percent and

Whereas such restricted planting of beets will seriously interfere with the ability of the water users to meet their construction payments to the United States Bureau of Reclamation, Farm Security Administration, and other Federal Agencies; and,

Whereas the production of sugar beets on reclamation projects permits of smaller farm units, thus providing more homes on these projects, and

Whereas the domestic production of sugar is approximately 26 percent of consumption: Now, therefore be it

Resolved by the National Reclamation Association composed of 16 Western States, assembled at Reno, Nev., October 11 to 13, that we protest to Secretary of Agriculture Henry Wallace the announced tentative allotment of sugar-beet acreage as being uneconomic, as being detrimental to the prosperity and well being of the Western Reclamation States, as seriously interfering with the operation and solvency of many Reclamation projects, and the stability of western agriculture, and that he be requested to make an allotment for 1939 in such a manner as will be equivalent to the unrestricted production of sugar beets.

11. That we urge upon the officers of this association that they lend their cooperation to the following program:

1. To have made a critical analysis and comparison of the water district laws of all the member States.
2. To distribute such information so that it will be available to reclamation interests throughout the West.
3. To urge upon these interests in each State the prime importance of securing from their State legislatures such changes and amendments to their laws as will give to their irrigation districts the powers they need to carry out the principles herein expressed, as a vital need to the sound and solvent progress of the western irrigation program.

12. That in the future no national forests, parks, monuments, or reservations should be established without a comprehensive study of all people and agencies concerned, including official organizations of the States and that such forests, parks, reservations, or monuments should under no condition be established unless such action is necessary for the preservation of landmarks, historic sites, or specific spots of interest to the touring public, or for the preservation of forests or watersheds, and when so established should be limited to cover the specific items intended to be protected, and then only with the provision for rights-of-way for construction and operation of water-use projects such as irrigation, power sites, etc.

13. That this association go on record as favoring and urging a program by the United States Bureau of Reclamation that will provide an adequate water supply for lands already under cultivation.

13½. Whereas perennial noxious weeds have become a most serious menace to American agriculture, including reclamation, as well as all other federally financed projects of the Western States; and,

Whereas individual farmers cannot finance and solve this problem by themselves; and,

Whereas the economic structure of America, in its entirety, is affected by the encroachment of these weeds upon farm lands: Now, therefore be it

Resolved, That the National Reclamation Association support the efforts of the National Weed Committee of the National Plant Board in the establishment of a national noxious weed program to be partly supported by Federal funds on a cooperative State-Federal basis, and that from such Federal lands there be provided to the United States Bureau of Reclamation or any other Federal bureau concerned, sufficient appropriations to conduct a program of prevention of perennial noxious weed infestations on new reclamation projects as well as on all other federally financed projects: Be it further

Resolved, That out of any Federal funds provided for noxious weed control, allocations be made to the proper Federal agencies for the eradication of these weeds upon federally owned or controlled lands.

14. Whereas continuation of Government Reclamation depends on the repayment of construction charges in order that the Reclamation fund may revolve as contemplated in the inception of the reclamation plan, and,

Whereas honor and good faith require such repayment, as well as the development of the West through the continuation of the reclamation program, and,

Whereas terms and rates of repayment have for many years been the subject of discussion and controversy, and,

Whereas in the past year a commission appointed by the Secretary of the Interior under authority of an act of Congress has studied repayment and associated questions and filed a comprehensive report thereon: Now, therefore be it

Resolved, That this association expresses its satisfaction in the progress toward a settlement of the repayment question indicated by the Repayment Commission study and report, reaffirms its position stated in resolution no. 1 adopted at its Casper meeting in 1937 that any satisfactory repayment plan must be based on the settler's ability to pay from the earnings of his land, urges upon the Bureau of Reclamation that so far and as fast as funds available make this possible, the Bureau put into effect these recommendations of the Repayment Commission report for which no legislative authority is necessary, endorses in general the plan in those portions of the report that relate directly to repayment for which legislation is required, recommends that the president of the association be authorized to appoint a special committee of three from the legislative committee to assist in the framing and passage of legislation relating to repayment in conformity with the principles adopted by the association, and as to collateral proposals, in view of the great diversity of interest involved therein, that the association take no action thereon but leave them for study by the Bureau and congressional committees, who will have ample opportunity to hear testimony and consider all phases thereof.

15. That the National Reclamation Association recommend to the Congress of the United States that the work of the Repayment Commission be continued and that said Commission make such further recommendations as may be necessary to meet the exigencies of the times until a repayment plan is enacted into law and put into effect: Be it further

Resolved, That we urge the adoption of legislation authorizing the Secretary of the Interior to make suitable adjustment of construction payments in the interim.

Homes or Havoc

(*Continued from page 221*)

tion projects. It might be wise, however, if additional projects of this type are to be constructed, to place them by law in a separate category and to define the methods of determining their relief value, in order that they be more fully understood, and in order that the program shall not be unbalanced.

The coming year will be a very busy one, but I can promise you that we will find time or make time to consider the problems before us. I do request the thoughtful assistance of the Western States in working out these matters. They vitally affect you and your children and are worthy of your best and most public-spirited effort.

Anticipation of the benefits to flow from this work, at this moment, is sustaining some who otherwise would abandon hope. One of these is parked, perhaps, in some auto camp in eastern Washington, newly arrived from a "dried out, blowed out" area. He has seen Grand Coulee Dam growing in the canyon of the great Columbia River. He has caught the vision of a vast, fine new empire as he drove through the dry lands of the Big Bend country. For his benefit, for the future of his family, for the good of our own western people, and for the welfare of the United States, his hopes must be realized.

LIST OF PRINCIPAL LABOR CONTRACTS

State	Project	Description of work	Contractor	Amount of contract	Work started	Probable date of completion	Percent complete
Arizona	Gila	Construction of Gila River crossing	Metropolitan Construction Co., Pasadena, Calif.	$337,376	Feb. 1938	Jan. 1940	31
Do	Salt River	Construction of Bartlett Dam	Barrett and Hilp and Macco Corporation, Clearwater, Calif.	2,236,224	Aug. 1936	Apr. 1939	93
Arizona-California	All-American Canal	Concrete drops and powerhouse structure.	Pleasant-Hassler Construction Co., Phoenix, Ariz.	675,390	June 1937	Mar. 1939	61
Do	do	do	Frank J. Kernan and John Klug, North Portland, Oreg.	743,649	do	do	32
Do	do	Earthwork, canal lining, and structure	Southwest Welding & Manufacturing Co., Alhambra, Calif.	111,504	Dec. 1937	Feb. 1939	80
Do	do	Construction of drop 1 and Coachella turnout.	Lewis-Chambers Construction Co., New Orleans, La.	145,119	Aug. 1937	July 1939	0.7
Do	do	Construction of structures	Atlas Construction Co., Pasadena, Calif.	262,240	July 1938	June 1939	18
Do	do	Earthwork, Coachella Branch Canal	W. E. Callahan Construction Co., Dallas, Tex., and J. P. Shipley, Los Angeles, Calif.	382,872	Aug. 1938	Aug. 1940	7
Do	do	Construction of canal crossings, check, and turnout.	Atlas Construction Co., Pasadena, Calif.	270,000	Sept. 1938	June 1939	2
Do	Parker Dam	Construction of Parker Dam and appurtenant works.	Six Companies, Inc., San Francisco, Calif.	5,622,000	Sept. 1934		91
California	Central Valley	Diversion tunnel and temporary relocation of S. P. R. R.	Colonial Construction Co., Spokane, Wash.	426,475	July 1938	Feb. 1939	15
Do	do	Earthwork, tunnel, canal lining, and structures, Contra Costa Canal.	Pearson, Minnis, and Moody and Werner and Webb, Los Angeles, Calif.	340,992	Aug. 1938	Oct. 1939	6
Do	do	Construction of Shasta Dam and power plant.	Pacific Constructors, Inc., Los Angeles, Calif.	35,939,450	Sept. 1938	Jan. 1944	0.4
Colorado	Pine River	Construction of Vallecito Dam	Martin Wunderlich Co., Jefferson City, Mo.	2,115,870	May 1938	Sept. 1942	16
Idaho	Boise-Payette	Earthwork, tunnel, canal lining, and structures.	Haas, Doughty, and Jones and Marshall and Stacy, San Francisco, Calif.	172,687	June 1938	Aug. 1939	48
Do	do	do	J. A. Terteling & Sons, Boise, Idaho	239,406	do	Mar. 1939	30
Idaho-Wyoming	Upper Snake River Storage.	Construction of Grassy Lake Dam	S. J. Groves & Sons Co., Minneapolis, Minn.	429,508	June 1937		45
Montana	Milk River	Construction of Fresno Dam	Wachter, O'Neil & McGarry Bros., Bismarck, N. Dak.	1,117,409	Mar. 1937	Feb. 1940	51
Nevada-California	Truckee Storage	Construction of Boca Dam	Geo. W. Condon, Omaha, Nebr.	738,405	Apr. 1937	July 1939	52
Texas	Colorado River	Construction of Marshall Ford Dam	Brown and Root Co., Inc., Austin, Tex.; McKenzie Construction Co., San Antonio, Tex.	6,647,368	Feb. 1937	do	64
Utah	Provo River	Construction of Deer Creek Dam and appurtenant works.	Rohl-Connolly Co., Los Angeles, Calif.	2,189,096	July 1938	Mar. 1942	13
Do	Sanpete	Construction of Spring City Tunnel	Dan Teters & Co., Inc., Riverside, Calif.	128,235	Nov. 1937	Feb. 1940	80
Washington	Columbia Basin	Completion of Grand Coulee Dam	Consolidated Builders, Inc., Oakland, Calif.	34,442,240	Mar. 1938	Feb. 1942	5
Do	do	Furnishing and erecting penstocks and pump inlet pipes.	Western Pipe & Steel Co., of California, San Francisco, Calif.	1,456,624	do	Nov. 1940	4
Do	Yakima-Roza	Earthwork, tunnel, and canal lining	T. E. Connolly Co., Los Angeles, Calif.	316,142	May 1938	Apr. 1939	24
Do	do	Earthwork, canal lining and structures	Haas, Doughty, and Jones and Marshall and Stacy, San Francisco, Calif.	140,294	July 1938	Feb. 1939	13
Do	do	Construction of Roza diversion dam, bench flume and railroad bridge.	Morrison-Knudsen Co., Inc., Boise, Idaho	526,860	Aug. 1938	Mar. 1940	7
Wyoming	Shoshone-Heart Mountain.	Earthwork, canal lining, and structures	Northwestern Engineering Co., Rapid City, S. Dak.	173,604	Apr. 1938	Mar. 1939	77
Do	Kendrick	Construction of Seminoe Dam and power plant.	Winston Bros. Co., Minneapolis, Minn.; Morrison-Knudsen Co., Boise, Idaho; Utah Construction Co., Ogden, Utah.	3,631,371	Jan. 1936		83
			Total, 29 contracts	101,958,410			

Progress of Investigations of Projects

ARIZONA-CALIFORNIA: *Colorado River Valleys surveys.*—Work was continued on the preparation of the aerial mosaic of the area along the lower Colorado River and Gila River.

CALIFORNIA: *Kings River-Pine Flat project.*—Topographic surveys and diamond drilling were completed at the Tehipite dam site and a reconnaissance was made of the Wishon dam site on the North Fork of the Kings River.

COLORADO: *Blue River transmountain diversion.*—A study was begun of the power development to determine the size and cost of plants. Preparation of report of project was continued.

Eastern slope surveys.—Water supply studies were continued for the North Republican River project and report is in course of preparation. Reports of the Smoky Hill, South Republican and Arickaree projects are also being written, and flood control studies of Trinidad project were continued.

Western slope surveys.—Work was continued on the water supply studies of Collbran project; a supplemental water supply study for the Florida project; surveys continued of the La Plata project; surveys and water supply studies continued of Paonia project; and preparations begun for diamond drilling at the Harvey Gap dam site, silt project.

IDAHO: *Cabinet Gorge project.*—Report was completed and forwarded to the Commissioner for review.

Southwest Idaho.—Surveys were continued of Tamarack and Canyon Creek reservoir sites and surveys completed of the Willow Creek and geological examinations were made of a number of dam sites, tunnel and canal lines; and hydrometric data secured in the Weiser River watershed. Work was continued on report of water supply of the Payette River Basin.

Snake River storage—South Fork.—Diamond drilling at the Elk Creek dam site was completed. Preparation of designs for the dam at Elk Creek site was in progress.

MONTANA: *Marias project.*—Sixty-one miles of canal was surveyed from Briggs to Rudyard. A geologic examination was made and diamond drilling begun at Shelby dam site. Classification of 256,000 acres of land was made.

MONTANA-NORTH DAKOTA: *Fort Peck pumping project.*—Investigations of the project were planned, work to be commenced at an early date.

OKLAHOMA: *Fort Supply project.*—Field work was completed and studies of water requirements of land prepared.

OREGON: *Grande Ronde project.*—Work was continued on preparation of drawings for the report.

Medford project.—Studies of water requirements of the land and available water supply were in progress.

SOUTH DAKOTA: *Black Hills.*—Field work was begun in the vicinity of Hot Springs and work was initiated on studies for dams at Horse Camp and Angostura sites.

Shadehill project.—Preparations were made for commencing field work in the near future.

(*Continued on page 235*)

CCC Rebuilds Deer Flat Reservoir Embankments

THE Deer Flat Reservoir, constructed about 30 years ago, is an inland storage reservoir in the Boise Valley of southwestern Idaho, which is filled through 30 miles of feeder canal from the Boise River during the winter season. The reservoir is located on the plains between the Boise and Snake Rivers about 10 miles south and west of Nampa and 6 miles south of Caldwell in Canyon County, Idaho.

Two main embankments were necessary to block the outlets from the natural reservoir basin. These were originally built of earth and gravel. The location is subject to high winds and the prevailing winds are from the northwest and the southeast, lengthwise of the reservoir, causing heavy punishment to the embankments from wave action. Within the first 2 or 3 years of service it was necessary to add a heavy blanket of coarse gravel to the upstream face of both embankments. Even this treatment did not prove sufficient to keep the waves from eating into the crests when the reservoir was nearly filled and material had to be added at intervals to maintain safe top widths.

When, in 1935, the services of CCC enrollees were made available for project improvements, it was decided that the chronic erosion on the Deer Flat embankments could be cured permanently by protecting the upstream faces near the crest with heavy riprap and a parapet wall. Camp BR-24 was located at the end of the lower embankment and work was begun in the fall of 1935.

As shown in one of the accompanying photographs, the upstream face at the top of the lower embankment prior to reconstruction was found to be standing nearly vertical for a height of 10 to 15 feet.

Upstream face lower embankment prior to reconstruction

Type of Construction

The type of construction used in the improvement involved reshaping the upstream face of the embankment with gravel fill to a true 1½ to 1 slope for a vertical height of 12 to 15 feet down from the crest. Heavy rock riprap with a minimum thickness of 24 inches was then laid dry on this slope. The riprap was protected at the bottom by a toe wall 2½ feet thick, laid in a trench 3 feet deep, and further reinforced on the outside by an apron of riprap 4 feet wide and 1½ feet thick.

At the top of the riprapped slope, a parapet wall was built with footing 1 to 2 feet deep and top extending 3 feet high above the crest of the embankment. This parapet was laid in mortar, true to line and grade, and with square posts projecting above the top of the wall at intervals of 100 feet.

Rock for the lower embankment was quarried from an exposed lava flow near Lizard Butte, about 3 miles away. For the upper embankment, however, the rock was gathered from spoil banks along the canals and the average haul was 9 miles. Quarry rock could be broken to about the proper size and the thickness of riprap was kept at near the designed requirement. When field stone was picked up or material gathered from spoil banks, it was convenient to use many larger pieces and for that reason the riprap on the upper embankment averages about 30 percent greater thickness than the lower embankment.

The lower embankment is 6,800 feet long, over a mile in length, and the upper embankment is short a mile, being 4,000 feet long. Construction quantities on the lower embankment, which is now complete, included 16,000 cubic yards gravel, 6,000 cubic yards rock in the parapet and toe wall, and 13,000 cubic yards rock for riprap. Due to the increased thickness, the work on the shorter upper embankment will be nearly equal in quantity.

When the work was first started, it was planned to use hand labor as far as possible. It soon developed that too much time would be required for completion by this method, particularly as other important work was waiting to be done and power equipment was used to some extent. Gravel for reshaping the slope was loaded by a dragline loaned by the water users' project organization. Rock was dragged to loading platforms by a 20-horsepower tractor and a 35-horsepower tractor and bull-dozer. The rock was then loaded on the trucks by means of hoists. Derricks were improvised to place the larger pieces at the embankment. Air compressors, drills, and explosives were used to break up the rock at the quarries.

Work Well Done

The work has been exceptionally well done. The CCC boys have worked hard and with enthusiasm and are proud of the permanent structure that has grown under their hands. The boys quickly developed skill and apitude at the job. Especially in the parapet, the finished wall is attractive in appearance and gives an impression of permanence and

stability. The enrollees have learned something of the way to operate drills, compressors, hoists, and tractors, to handle big rock with all sorts of mechanical devices, and by sheer strength. They have learned to keep true to line and grade and to admire the effect on the great length of the wall and paving they have built. At first, the end of an enrollment period caused considerable disruption, but such times are now noticeable only by the reduction in the number of men available. The boys staying in camp go along now as if nothing had happened. When new enrollees arrive, they are absorbed into the company at once and in a few days it is hard to tell who the new enrollees are.

A much-used paved road follows the crest of the lower embankment and passersby, many of them project water-users interested in the appearance and permanence of the reservoir, are free with their praise of the work that is being done. It is, without doubt, one of the most popular local CCC projects and the finished work will stand as an enduring monument to the CCC boys, and the assistance they have rendered to the people of the Boise Valley in the conservation of their greatest asset—irrigation water.

Toe wall and gravel slope ready for rock riprapping

Upstream face lower embankment completed reconstruction

Oregon Reclamation Congress Meets at Redmond

FIVE THOUSAND persons joined in a program of the Oregon Reclamation Congress at Redmond, Oreg., on October 21-22. This meeting, held in conjunction with the formal opening of the Redmond CCC Camp, and the start of work on the 65-mile North Unit Canal, part of the $8,000,000 Wikiup project, was exceptionally well attended.

Simultaneous blasts, from dynamite strung along a 100-foot section of the canal, sent a cloud billowing into the sky. Representative Walter W. Pierce grasped one handle of an electric plunger and C. C. Fisher, construction engineer of the Deschutes project, held the other handle.

The military staff headed by Capt. B. A. Johnson, camp commander, extended greetings, and he was followed by Mayor Parker of Redmond, Mayor Simpson of Bend, and Howard W. Turner of Madras. Hon. Walter M. Pierce, Member of Congress from eastern Oregon, also extended greetings and this was followed by the reading of letters and telegrams.

Nevada State Fair

AT the State fair held in Fallon, Nev., on September 22–25, local 4–H and Future Farmers boys clubs displayed fine exhibits. Douglas County took first prize for the market class of potatoes and Washoe County won on the baking class, and carried off several ribbons for other products.

New England Hurricane Affects Reclamation CCC Program

EVIDENCE that the recent hurricane in New England had far-reaching effect, is the announcement from the Office of the Director, CCC, that the need for retaining CCC companies in the storm-twisted area will require the delayed occupancy of several western camps planned for occupancy by the Bureau of Reclamation and the Division of Grazing during the twelfth enrollment period, October 1, 1938, through March 31, 1939.

The two reclamation camps affected are Camp BR–74, Yuma, Ariz., and Camp BR–87, Cody, Wyo. These camps were to be occupied by CCC companies transferred from New England. While suspension of these camps will cause some delay in their planned work programs, it is not regretted, representing, as it does, a contribution made by one section of the country to help a stricken area in another section.

DIRECTORY OF APPROVED CCC CAMPS

Twelfth Enrollment Period—Oct. 1, 1938, to Apr. 1, 1939

Camp No.	Camp name	Reclamation project	Camp location			Regional director	Director's post-office address	Army corps area
			Post office	County	State			
BR-1	Lake Minatare	North Platte	Minatare	Scotts Bluff	Nebraska	C. F. Gleason	Guernsey, Wyo	
BR-2	Fruitdale	Belle Fourche	Fruitdale	Butte	South Dakota	F. C. Youngblutt	Newell, S. Dak	
BR-3	Carlsbad	Carlsbad	Carlsbad	Eddy	New Mexico	L. E. Foster	Carlsbad, N. Mex	
BR-4	Ysleta	Rio Grande	Ysleta	El Paso	Texas	L. R. Fiock	El Paso, Tex	
BR-7	Shoshone	Shoshone	Deaver	Big Horn	Wyoming	L. J. Windle	Powell, Wyo	
BR-8	Elephant Butte	Rio Grande	Elephant Butte	Sierra	New Mexico	L. R. Fiock	El Paso, Tex	
BR-11	Bridgeland	Moon Lake	Bridgeland	Duchesne	Utah	E. O. Larson	Provo, Utah	
BR-13	Yuma	Yuma	Yuma	Yuma	Arizona	C. B. Elliott	Yuma, Ariz	
BR-22	Grand Valley	Grand Valley	Grand Junction	Mesa	Colorado	W. J. Chiesman	Grand Junction, Colo	
BR-23	Montrose	Uncompahgre	Montrose	Montrose	do	E. P. Anderson	Montrose, Colo	
BR-24	Deer Flat	Boise	Huston	Canyon	Idaho	R. J. Newell	Boise, Idaho	
BR-27	Minidoka	Minidoka	Rupert	Minidoka	do	D. Templin	Burley, Idaho	
BR-30	Sidney	Lower Yellowstone	Sidney	Richland	Montana	H. H. Johnson	Malta, Mont	
BR-34	Newlands	Newlands	Fallon	Churchill	Nevada	G. B. Snow	Reno, Nev	
BR-35	Carson River	do	do	do	do	do	do	
BR-39	Las Cruces	Rio Grande	Las Cruces	Dona Ana	New Mexico	L. R. Fiock	El Paso, Tex	
BR-41	Klamath	Klamath	Merrill	Klamath	Oregon	B. E. Hayden	Klamath Falls, Oreg	
BR-42	Ontario	Owyhee	Ontario	Malheur	do	R. J. Newell	Boise, Idaho	
BR-43	Nyssa	do	Nyssa	do	do	do	do	
BR-45	Vale	Vale	Vale	do	do	C. C. Ketchum	Vale, Oreg	
BR-53	Mitchell	North Platte	Mitchell	Scotts Bluff	Nebraska	C. F. Gleason	Guernsey, Wyo	
BR-54	Cristobal	Rio Grande	Elephant Butte	Sierra	New Mexico	L. R. Fiock	El Paso, Tex	
BR-56	Paul	Minidoka	Paul	Minidoka	Idaho	D. Templin	Burley, Idaho	
BR-57	Ballantine	Huntley	Ballantine	Yellowstone	Montana	L. J. Windle	Powell, Wyo	
BR-58	Sunnyside	Yakima	Sunnyside	Yakima	Washington	J. S. Moore	Yakima, Wash	
BR-59	Mesa	Grand Valley	Palisade	Mesa	Colorado	W. J. Chiesman	Grand Junction, Colo	
BR-64	Deer Creek	Provo River	Heber	Wasatch	Utah	E. O. Larson	Provo, Utah	
BR-66	Cowiche	Yakima	Naches	Yakima	Washington	J. S. Moore	Yakima, Wash	
BR-69	Malta	Milk River	Malta	Phillips	Montana	H. H. Johnson	Malta, Mont	
BR-71	Uncompahgre	Uncompahgre	Montrose	Montrose	Colorado	E. P. Anderson	Montrose, Colo	
BR-72	Powell	Shoshone	Powell	Park	Wyoming	L. J. Windle	Powell, Wyo	
BR-73	Kuna	Boise	Meridian	Ada	Idaho	R. J. Newell	Boise, Idaho	
BR-78	Orland	Orland	Orland	Glenn	Calif	D. L. Carmody	Orland, Calif	
BR-79	Alcova [1]	Kendrick	Casper [1]	Natrona	Wyo	H. W. Bashore	Casper, Wyo	
BR-80	Sun River [1]	Sun River	Augusta	Lewis & Clark	Mont	A. W. Walker	Fairfield, Mont	
BR-82	Carlsbad Springs	Carlsbad	Carlsbad	Eddy	N. Mex	L. E. Foster	Carlsbad, N. Mex	
BR-83	Veteran	North Platte	Veteran	Goshen	Wyo	C. F. Gleason	Guernsey, Wyo	
BR-84	Redding No. 1 [1]	Central Valley	Redding [1]	Shasta	Calif	R. Lowry	Redding, Calif	
BR-85	Redding No. 2 [1]	do	do.[1]	do	do	do	do	
BR-88	Redmond No. 1	Deschutes	Redmond	Deschutes	Oreg	C. C. Fisher	Bend, Oreg	
BR-89	Redmond No. 2	do	do	do	do	do	do	
BR-90	Redmond No. 3	do	do	do	do	do	do	

[1] Subject to change.

All camps are of all-year type construction.
General supervision exercised by: R. F. Walter, Chief Engineer, Bureau of Reclamation, Denver, Colo.; A. R. Golzé, Supervising Engineer, CCC, Bureau of Reclamation, Washington, D. C
Under direction of: John C. Page, Commissioner, Bureau of Reclamation, Washington, D. C.

Articles on Irrigation and Related Subjects

By W. I. SWANTON, ***Engineering Division***

BISSELL, C. A.

Specifications for Colorado River Aqueduct make extensive library, Southwest Builder and Contractor, Sept. 30, 1938, Vol. 92, No. 14, p. 10.

BLANKE, JOHN H. D.

Building highlights of Grand Coulee, illus., The International Engineer, September 1938, Vol. 74, No. 3, pp. 69–74 (continued).

BOBISCH, WM. J., *and* HOLVARD W. BIRKELAND

Finite beams on elastic soil foundations with special applications, Technical Memorandum No. 580, Aug. 13, 1938, 54 pp., Price $2. Office Chief Engineer, Denver, Colo.

BOCA DAM

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THE RECLAMATION ERA • NOVEMBER 1938

CUT ALONG THIS LINE

COMMISSIONER, (Date)...

Bureau of Reclamation,
Washington, D. C.

SIR: I am enclosing my check[1] (or money order) for $1.00 to pay for a year's subscription to THE RECLAMATION ERA.

Very truly yours,

November 1938

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...

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Controlling Perennial Weeds in Oregon by Pasturing[1]

MANY people have tried to get out of the weed-growing class by pasturing their weeds. This method of course has a thousand variations, depending on climate, type of soil, kind of weed, and kind of livestock used. One of the commonest and most successful types—goat pasturing—is practiced largely in the coast counties and in Douglas County. The goats clear land of brush and some troublesome weeds. They eat St. Johnswort when it is young and reduce fern to some extent. Pasturing plus a sod-forming grass will keep fern under control.

Reports of killing morning glories with hogs are frequent. It is rough on the hogs to keep them so hungry that they will work the ground over and over searching for the roots, but such pasturing for two seasons of sometimes kills small patches. One man reports that he planted artichokes on his morning-glory land and that gave the hogs an added reason for rooting.

Garden plots have a depressing and discouraging habit of changing into morning-glory patches, and some Oregon people have thereupon put chicken yards upon such ground. Chickens like the morning-glory leaves and keep them eaten down so that the roots may die in 4 or 5 years, provided poultry diseases and parasites do not get the chickens first. Continuous pasturing of chickens on the same land may be fatal to poultry profits.

Other more extensive types of pasturing are frequent. The easiest thing to do with quackgrass is to pasture it, and it makes a great deal of very good pasture. But as weeds are weeds mostly because cattle do not like them as well as grass, this pasture method is more likely to reduce the spread of weeds than to kill them. Canada thistles are not eaten much unless stock get very hungry. One Wallowa County farmer sprayed his thistles with salt, and his hundred head of steers ate them with enthusiasm. He reports that he killed a fine stand of thistles in 2 years by keeping them eaten to the ground in this way.

Two of the three common kinds of white top, except when young, are not relished by any kind of animals. Furthermore, that weed goes to seed early, at a time of the year when more palatable feed is abundant. If animals are kept on short pasture, they will eat these seeds and scatter the weed whereever they go. Pasturing is, therefore, more likely to spread white top than to stop it.

Sheep like many kinds of weeds. Buckhorn, for example, is seeded in many sheep pastures in Douglas and Coos Counties. Morning-glory fields have been converted to sheep pastures all over the State.

A grower in Wasco County, in a letter telling of his experience in using sheep to control morning-glory, states:

"We practice clean cultivation of orchards here, and I have one block of pear orchard that, over a period of years, has become completely covered with morning-glory. Cultivation in an orchard does nothing but improve the stand of morning-glory, so feeling sure that chemical applications would ruin the orchard, I was compelled to figure some other method of handling this problem."

"I placed a woven-wire fence around this orchard, turned a small bunch of Hampshire sheep in it, and find that the morning-glory is being killed out and the sheep do very well. They do not bark the trees and they keep the windfall fruit cleaned up, as well as the sucker growth from injured roots.

"I disk this orchard deep in the spring and loosen it up occasionally in the summer with a Kimball weeder, and the morning-glory never gets to vine out, as the sheep seem very partial to this young tender growth.

"Another small piece of morning-glory I made a hog lot of and kept hogs there 2 years. They went down about 2 feet after those morning-glory roots, and it seems to have cleaned that piece as I have farmed it now for about 8 years.

"I have a field of about 5 acres that is full of morning-glory, and I am letting this field remain idle and pasturing sheep in it. I believe that after 3 years I will be able to get a stand of alfalfa there and in the meantime the sheep are paying a small profit."

A farmer in Multnomah who used alfalfa plus sheep for weed control writes:

"Regarding the control of morning-glory on my property in Clark County, we did have a very heavy infestation and for a number of years, while growing annual crops in the infested district, we found it practically impossible to control them. However, after planting alfalfa and grazing the alfalfa with sheep both during the early growing season and after each cutting of hay, a well as late in the season, we found that th infestation of morning-glory has entirely dis appeared.

"We noticed that the morning-glory plan was apparently quite palatable, but whethe the heavy pasturing or the competition o the alfalfa combined with the pasturing wa the cause of the eradication we are not pre pared to say. However, it remains a fac that the infestation has entirely disappeare without any cultural or chemical efforts to ward control."

All of the growers interviewed agreed tha several years of pasturing made the weed easier to kill either by chemicals or clea cultivation. The repeated damage to th tops probably reduced the root area an thereby diminishes the amount of store food in the roots. If a grower has too man weeds to clean up in 1 year's time and i starting on a conscientious weed-control pro gram aimed at eventual elimination of th weeds from his farm, pasturing is one of th best ways to tie the weeds down and hol them until he can get around to more drasti measures. Weeds such as white top an Canada thistle, which bear seed in pasture should be cut early enough and often enoug to keep seed from forming. Some low-grow ing weeds such as morning-glories cannot b prevented from forming seeds by cutting but fortunately the morning-glories do no produce much seed after a year or two o pasturing.

[1] From Control of Perennial Weeds in Oregon by E. R. Jackman, Extension Specialist in Farm Crops; Lawrence Jenkins, Assistant Crops Specialist; C. A. Henderson, County Agricultural Agent of Klamath County; W. A. Holt, County Agricultural Agent of Umatilla County; and H. G. Avery, County Agricultural Agent of Union County, recently issued by Oregon State College as Extension Bulletin 510.

Salt River Crops

PRACTICALLY all project crops on the Sa River project are in good condition. Becaus of the 12 months' growing and irrigation sea son two crops are grown on some 50,000 acre of this project during the year.

The principal double crops consist com monly of corn, maize, spring and fall lettuc melons, cantaloups, potatoes, and the grain

Milk River Sugar Beets

APPROXIMATELY 16,000 acres of suga beets will be harvested in the factory distric of the Milk River project this season. Thi will provide the largest tonnage and longes campaign of record.

NOTES FOR CONTRACTORS

Specifications No.	Project	Bids opened	Work or material	Low bidder		Bid	Terms	Contract awarded
				Name	Address			
788	Columbia Basin, Wash.	1938 Sept. 7	Turbines, governors, and generators for station service units at Grand Coulee power plant.	The Pelton Water Wheel Co.	San Francisco, Calif.	[1] $106,498.00		1938 Sept. 26
				Woodward Governor Co.	Rockford, Ill.	[2] 19,236.00		Do.
				Westinghouse Electric & Manufacturing Co.	Denver, Colo.	[3] 193,480.00	F. o. b. East Pittsburgh, Pa.	Do.
798	Shoshone-Heart Mountain, Wyo.	do	Control works and tunnels for Shoshone Canyon conduit, stations 0+00 to 8+50.	Utah Construction Co.	Ogden, Utah	233,332.00		[5]
794	do	Aug. 31	Earthwork, tunnel, bench flumes, canal lining, and structures, Heart Mountain Canal, stations 920 to 947+50, 981+95 to 1229.	Barnard-Curtiss Co.	Minneapolis, Minn.	304,850.00		Sept. 24
799	Kendrick, Wyo.	Sept. 21	Transmission line from Cheyenne, Wyo., to Gering, Nebr.	Fritz Ziebarth	Long Beach, Calif.	31,823.00		Oct. 11
1113-D	Yuma, Ariz.	Sept. 9	One clutch-operated, crawler-traction-mounted, full-revolving, Diesel-engine-powered, convertible-type, dragline excavator.	Bay City Shovels, Inc.	Bay City, Mich.	11,450.00	Discount ½ percent.	Sept. 30
1114-D	Boise-Payette, Idaho	Sept. 12	Structures D-Line Canal laterals 2.1 to 18.7.	Henry L. Horn	Caldwell, Idaho	21,785.00		Do.
1116-D	do	Sept. 14	Radial gates and radial-gate hoists, Black Canyon Canal and D-Line Canal.	Ogden Iron Works	Ogden, Utah	[4] 1,390.00		Sept. 28
				do	do	[6] 588.00		Do.
				John W. Beam	Denver, Colo.	[7] 700.00		Do.
				Ogden Iron Works	Ogden, Utah	[8] 300.00		Do.
1117-D	All-American Canal, Ariz.-Calif.	Sept. 16	Materials for steel warehouse at Imperial Dam.	Illinois Steel Bridge Co.	Jacksonville, Ill.	1,619.00	Discount ½ percent.	Sept. 30
1120-D	Boulder Canyon, Ariz.-Nev.	Sept. 22	One carbon-dioxide, fire extinguishing system for Boulder power plant.	C-O-Two Fire Equipment Co.	Newark, N. J.	[4] 2,537.25	F. o. b. Boulder City, Nev.	Oct. 7
1121-D	Kendrick, Wyo.	Sept. 23	Supporting structures for Cheyenne and Greeley substations.	Worden-Allen Co.	Milwaukee, Wis.	6,681.00	Discount ½ percent.	Oct. 6
B-47,263-A	Central Valley, Calif.	Aug. 30	Galvanized corrugated metal pipe and couplings.	California Corrugated Culvert Co.	Berkeley, Calif.	[9] 20,781.20	do	Oct. 10
46,174-A	Colorado-Big Thompson, Colo.	Sept. 9	Poles and cross arms	Oeser Cedar Co.	Bellingham, Wash.	[1] 25,057.00	F. o. b. Orofino, Idaho and Bellingham; discount ½ percent.	Sept. 26
				B. F. Vreeland	Denver, Colo.	[2] 4,153.20	F. o. b. Cottage Grove, Oreg.; discount 1 percent.	
795	Columbia Basin, Wash.	Sept. 2	Fish traps for migratory fish control at Rock Island Dam.	Kern and Kibbe	Portland, Oreg.	90,932.65		Oct. 19
1119-D	Belle Fourche, S. Dak.	Sept. 19	One ditch-cleaning and excavating machine	Ruth Dredger Manufacturing Corporation.	Los Angeles, Calif.	11,975.00	Discount ½ percent.	Oct. 14

[1] Schedule 1. [2] Schedule 2. [3] Schedule 3. [4] Item 1. [5] All bids rejected. [6] Item 2. [7] Item 3. [8] Item 4. [9] Schedules 1, 2, and 3.

Progress of Investigations of Projects

(*Continued from page 229*)

UTAH: *Gooseberry.*—Preparations were continued of report on the Price River development and the Gooseberry investigations.

Weber River.—Topographic surveys of reservoirs on Farmington and Hobbs Creeks were completed.

UTAH-IDAHO-WYOMING: *Bear River surveys.*—Investigations were made of dam sites in the Oneida Narrows and in the Nounan Valley. Studies were made of Bear River for control of inflow below Bear Lake and for an enlarged Cutler Reservoir. Studies of a reservoir at Woodruff Narrows in Wyoming were begun.

Colorado River Basin.—A report of the land classification of the Colorado River Basin was in course of preparation.

Minidoka Dairy Records

HIGH records have been maintained by the cows in the Twin Falls-Mini-Cassia Cow Testing Association. Thomas Maberly's herd of three registered Holsteins, near Rupert, averaged 57.9 pounds of butterfat and 1,630 pounds of milk per cow in August, and Frank L. Coffey's 15-cow herd of Guernseys averaged 39.3 pounds of butterfat and 862 pounds of milk per cow.

The opening of bids in connection with the relocation of a railroad on the Central Valley Project, California, resulted in the abstract above held by Assistant Commissioner Williams and Wesley R. Nelson, Chief of Engineering Division

Reclamation Organization Activities

Commissioner Page Returns to Washington

JOHN C. PAGE, Commissioner of Reclamation, returned to the Washington Office on October 31, after attending the annual meeting of the National Reclamation Association in Reno October 11–13, and immediately following a conference at Boulder City, Nev., of the supervisory staff of the Bureau of Reclamation.

Mr. Page accompanied Secretary Ickes on his tour of the Southwest, which included the dedication of the Imperial Dam and the turning of the first water into the All-American Canal.

Mr. Page will attend the meeting, November 14–16, in Chicago, of the Association of Land-Grant Colleges, and will deliver an address on November 16 on the subject "The Federal Reclamation Program."

W. R. Nelson Addresses Students

WESLEY R. NELSON, Chief of the Engineering Division of the Washington office, delivered an illustrated lecture on October 14 before the student body of the George Washington University, his subject being Unusual Features of Construction. Following Mr. Nelson's lecture the sound motion-picture film of Boulder Dam was shown.

I. A. Winter at Meeting Power Division ASCE

I. A. WINTER, Senior Engineer in the Denver office of the Bureau, prepared a paper on the subject, Progress and Economic Development and Design of Turbines and Appurtenances, which was read at the meeting in New York on October 13–14 of the power division of the American Society of Civil Engineers.

L. W. Hamilton to Attend Meeting on Soils Investigations

L. W. HAMILTON, Associate Engineer in the Denver office of the Bureau, will attend and deliver a paper on The Compaction of Earth Embankments at the meeting in Washington, during the week beginning November 28, of the Department of Soils Investigations of the Highway Research Board.

While in the city Mr. Hamilton will visit the Washington office and confer with the Chief of the Engineering Division on the subject of investigations in soil mechanics.

Upstream view of Arrowrock Dam spillway carrying 6,822 second-feet

PERSONNEL CHANGES

THE following recent personnel changes in the Bureau of Reclamation have been authorized by the Secretary of the Interior:

Appointments

Denver office:

Clarence E. Meyerdick, associate engineer, from War Department.

Alf Raymond Paim, junior engineer, from War Department.

Fred J. Schnitzer, assistant engineer.

Joseph W. Jewel, assistant engineer.

Thomas A. McLennan, assistant engineer.

Columbia Basin project:

Ferber R. Schleif, junior engineer.

Colorado-Big Thompson project:

Porter J. Preston, supervising engineer, formerly senior engineer.

Transfers

To Washington:

Ralph W. Sullivan, supervising engineer, CCC division, from Camp Superintendent, CCC, Meridian, Idaho.

To Denver:

Jerome M. Raphael, assistant engineer, formerly junior engineer, War Department.

To Ogden River project:

Norman T. Olson, engineer, from Kendrick project, Wyoming.

Reinstatements

Colorado-Big Thompson project:

Cleves H. Howell, senior engineer.

Richard B. Ward, engineer.

Separation

Washington Office:

Marshall G. Jones, associate economic analyst (temporary appointment) close September 30, to be employed in P. W. A.

Butte County (S. Dak.) Fair

THE Butte County Fair (Belle Fourche project) held on September 8–10, had outstanding exhibits in agriculture, livestock sales, and 4–H and community displays. The Horse-Creek group captured blue ribbons in community and women's clubs departments.

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ADMINISTRATIVE ORGANIZATION OF THE BUREAU OF RECLAMATION

HAROLD L. ICKES, SECRETARY OF THE INTERIOR

E. K. BURLEW, FIRST ASSISTANT SECRETARY and Budget Officer (in charge of reclamation)

John C. Page, Commissioner — Roy B. Williams, Assistant Commissioner

J. Kennard Cheadle, Chief Counsel and Assistant to Commissioner; Miss Mae A. Schnurr, Chief, Division of Public Relations; George O. Sanford, General Supervisor of Operation and Maintenance; D. S. Stuver, Asst. Gen. Supr.; Wesley R. Nelson, Chief, Engineering Division; P. I. Taylor, Assistant Chief; A. R. Golzé, Supervising Engineer, C. C. C. Division; W. E. Warne, Director of Information; William F. Kubach, Chief Accountant; Charles N. McCulloch, Chief Clerk; Jesse W. Myer, Chief, Mails and Files Division; Miss Mary E. Gallagher, Secretary to the Commissioner

Denver, Colo., United States Customhouse

R. F. Walter, Chief Eng.; S. O. Harper, Asst. Chief Eng.; J. L. Savage, Chief Designing Eng.; W. H. Nalder, Asst. Chief Designing Eng.; L. N. McClellan, Chief Electrical Eng.; Kenneth B. Keener, Senior Engineer, Dams; H. R. McBirney, Senior Engineer, Canals; E. B. Debler, Hydraulic Eng.; I. E. Houk, Senior Engineer, Technical Studies; Spencer L. Baird, District Counsel; L. R. Smith, Chief Clerk; Vern H. Thompson, Purchasing Agent; C. A. Lyman and Henry W. Johnson, Examiners of Accounts; L. S. Davis, Engineer, C. C. C. Division

Projects under construction or operated in whole or in part by the Bureau of Reclamation

Project	Office	Official in charge		Chief clerk	District counsel	
		Name	Title		Name	Address
All-American Canal [1]	Yuma, Ariz.	Leo J. Foster	Constr. engr.	J. C. Thrailkill	R. J. Coffey	Los Angeles, Calif.
Belle Fourche	Newell, S. Dak.	F. C. Youngblutt	Superintendent	J. P. Siebeneicher	W. J. Burke	Billings, Mont.
Boise	Boise, Idaho	R. J. Newell	Constr. engr.	Robert B. Smith	B. E. Stoutemyer	Portland, Oreg.
Boulder Dam and power plant [1]	Boulder City, Nev.	Irving C. Harris	Director of Power	Gail H. Baird	R. J. Coffey	Los Angeles, Calif.
Buffalo Rapids	Glendive, Mont.	Paul A. Jones	Constr. engr.	Edwin M. Bean	W. J. Burke	Billings, Mont.
Carlsbad	Carlsbad, N. Mex.	L. E. Foster	Superintendent	E. W. Shepard	H. J. S. Devries	El Paso, Tex.
Central Valley	Sacramento, Calif.	W. R. Young	Supervising engr.	E. R. Mills	R. J. Coffey	Los Angeles, Calif.
Kennett Div. (Shasta Dam)	Redding, Calif.	Ralph Lowry	Constr. engr.		R. J. Coffey	Los Angeles, Calif.
Colorado-Big Thompson	Denver, Colo.	Porter J. Preston	Supervising engr.	C. M. Voyen	J. R. Alexander	Salt Lake City, Utah.
Colorado River	Austin, Tex.	Ernest A. Moritz	Constr. engr.	William F. Sha	H. J. S. Devries	El Paso, Tex.
Columbia Basin	Coulee Dam, Wash.	F. A. Banks	Constr. engr.	C. B. Funk	B. E. Stoutemyer	Portland, Oreg.
Deschutes	Bend, Oreg.	C. C. Fisher	Engineer	James A. Dolphin	B. E. Stoutemyer	Portland, Oreg.
Fruit Grower's Dam	Montrose, Colo.		Constr. engr.	Ewalt P. Anderson	J. R. Alexander	Salt Lake City, Utah.
Gila	Yuma, Ariz.	Leo J. Foster	Constr. engr.	J. C. Thrailkill	R. J. Coffey	Los Angeles, Calif.
Grand Valley	Grand Junction, Colo.	W. J. Chiesman	Superintendent	Emil T. Ficenec	J. R. Alexander	Salt Lake City, Utah
Humboldt	Lovelock, Nev.	Stanley R. Marean	Superintendent	George B. Snow	J. R. Alexander	Salt Lake City, Utah
Kendrick	Casper, Wyo.	H. W. Bashore	Constr. engr.	George W. Lyle	W. J. Burke	Billings, Mont.
Klamath	Klamath Falls, Oreg.	B. E. Hayden	Superintendent	W. I. Tingley	B. E. Stoutemyer	Portland, Oreg.
Milk River	Malta, Mont.	H. H. Johnson	Superintendent	E. E. Chabot	W. J. Burke	Billings, Mont.
Fresno Dam	Havre, Mont.	H. V. Hubbell	Constr. engr.	E. E. Chabot	W. J. Burke	Billings, Mont.
Minidoka	Burley, Idaho	Dana Templin	Superintendent	G. C. Patterson	B. E. Stoutemyer	Portland, Oreg.
Moon Lake	Duchesne, Utah	E. J. Westerhouse	Constr. engr.	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
North Platte	Guernsey, Wyo.	C. F. Gleason	Supt. of power	A. T. Stimpfig	W. J. Burke	Billings, Mont.
Orland	Orland, Calif.	D. L. Carmody	Superintendent	W. D. Funk	R. J. Coffey	Los Angeles, Calif.
Owyhee	Boise, Idaho	R. J. Newell	Constr. engr.	Robert B. Smith	B. E. Stoutemyer	Portland, Oreg.
Parker Dam	Parker Dam, Calif.	Howard P. Bunger	Constr. engr.		R. J. Coffey	Los Angeles, Calif.
Pine River	Bayfield, Colo.	Charles A. Burns	Constr. engr.	Frank E. Gawn	J. R. Alexander	Salt Lake City, Utah.
Provo River	Provo, Utah	L. O. Larson	Constr. engr.	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
Rio Grande	El Paso, Tex.	L. R. Fiock	Superintendent	H. H. Berryhill	H. J. S. Devries	El Paso, Tex.
Elephant Butte Power Plant	Engle, N. Mex.	Samuel A. McWilliams	Engineer	H. H. Berryhill	H. J. S. Devries	El Paso, Tex.
Riverton	Riverton, Wyo.	H. D. Comstock	Superintendent	C. B. Wentzel	W. J. Burke	Billings, Mont.
Salt River	Phoenix, Ariz.	E. C. Koppen	Constr. engr.	Edgar A. Peek	R. J. Coffey	Los Angeles, Calif.
Sanpete	Provo, Utah	E. O. Larson	Constr. engr.	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
Shoshone	Powell, Wyo.	L. J. Windle	Superintendent [2]	L. J. Windle [2]	W. J. Burke	Billings, Mont.
Heart Mountain division	Cody, Wyo.	Walter F. Kemp	Constr. engr.	L. J. Windle [2]	W. J. Burke	Billings, Mont.
Sun River, Greenfields division	Fairfield, Mont.	A. W. Walker	Superintendent		W. J. Burke	Billings, Mont.
Truckee River Storage	Reno, Nev.	Charles S. Hale	Constr. engr.	George B. Snow	J. R. Alexander	Salt Lake City, Utah
Umatilla (McKay Dam)	Pendleton, Oreg.	C. L. Tice	Reservoir supt.		B. E. Stoutemyer	Portland, Oreg.
Uncompahgre: Repairs to canals	Montrose, Colo.	Denton J. Paul	Engineer	Ewalt P. Anderson	J. R. Alexander	Salt Lake City, Utah.
Upper Snake River Storage [3]	Ashton, Idaho	H. A. Parker	Constr. engr.	Emmanuel V. Hillius	B. E. Stoutemyer	Portland, Oreg.
Vale	Vale, Oreg.	C. C. Ketchum	Superintendent		B. E. Stoutemyer	Portland, Oreg.
Yakima	Yakima, Wash.	J. S. Moore	Superintendent	Philo M. Wheeler	B. E. Stoutemyer	Portland, Oreg.
Roza division	Yakima, Wash.	Charles E. Crownover	Constr. engr.	Alex S. Harker	B. E. Stoutemyer	Portland, Oreg.
Yuma	Yuma, Ariz.	C. B. Elliott	Superintendent	Noble O. Anderson	R. J. Coffey	Los Angeles, Calif.

[1] Boulder Canyon. [2] Acting. [3] Island Park and Grassy Lake Dams.

Projects or divisions of projects of Bureau of Reclamation operated by water users

Project	Organization	Office	Operating official		Secretary	
			Name	Title	Name	Address
Baker (Thief Valley division) [1]	Lower Powder River irrigation district	Baker, Oreg.	A. J. Ritter	President	F. A. Phillips	Keating.
Bitter Root [4]	Bitter Root irrigation district	Hamilton, Mont.	N. W. Blindauer	Manager	Elsie H. Wagner	Hamilton.
Boise [1]	Board of Control	Boise, Idaho	Wm. H. Tuller	Project manager	L. P. Jensen	Boise
Boise [1]	Black Canyon irrigation district	Notus, Idaho	W. H. Jordan	Superintendent	L. M. Watson	Caldwell.
Burnt River	Burnt River irrigation district	Huntington, Oreg.	Edward Sullivan	President	Harold H. Hursh	Huntington
Frenchtown	Frenchtown irrigation district	Frenchtown, Mont.	Edward Donlan	President	Ralph P. Schaffer	Huson.
Grand Valley, Orchard Mesa [3]	Orchard Mesa irrigation district	Grand Jctn., Colo.	C. W. Tharp	Superintendent	C. J. McCormich	Grand Jctn.
Huntley [4]	Huntley irrigation district	Ballatine, Mont.	E. E. Lewis	Manager	H. S. Elliott	Ballatine.
Hyrum [3]	South Cache W. U. A.	Wellsville, Utah	B. L. Mendenhall	Superintendent	Harry C. Parker	Logan.
Klamath, Langell Valley [1]	Langell Valley irrigation district	Bonanza, Oreg.	Chas. A. Revell	Manager	Chas. A. Revell	Bonanza.
Klamath, Horsefly [1]	Horsefly irrigation district	Bonanza, Oreg.	Henry Schmor, Jr.	President	Dorothy Eyers	Bonanza.
Lower Yellowstone [4]	Board of Control	Sidney, Mont.	Axel Persson	Manager	Axel Persson	Sidney.
Milk River: Chinook division [4]	Alfalfa Valley irrigation district	Chinook, Mont.	A. L. Benton	President	R. H. Clarkson	Chinook.
	Fort Belknap irrigation district	Chinook, Mont.	H. B. Bonefright	President	L. V. Bogy	Chinook
	Zurich irrigation district	Harlem, Mont.	C. A. Watkins	President	H. M. Montgomery	Chinook
	Harlem irrigation district	Harlem, Mont.	Thos. M. Everett	President	Geo. H. Tout	Harlem
	Paradise Valley irrigation district	Zurich, Mont.	R. E. Musgrove	President	J. F. Sharples	Zurich.
Minidoka: Gravity [1]	Minidoka irrigation district	Rupert, Idaho	Frank A. Ballard	Manager	O. W. Paul	Rupert
Pumping [1]	Burley irrigation district	Burley, Idaho	Hugh L. Crawford	Manager	Frank O. Redfield	Burley.
Gooding [1]	Amer. Falls Reserv. Dist. No. 2	Gooding, Idaho	S. T. Baer	Manager	Ida M. Johnson	Gooding.
Newlands [3]	Truckee-Carson irrigation district	Fallon, Nev.	W. H. Wallace	Manager	H. W. Emery	Fallon
North Platte: Interstate division [4]	Pathfinder irrigation district	Mitchell, Nebr.	T. W. Parry	Manager	Flora K. Schroeder	Mitchell.
Fort Laramie division [4]	Gering-Fort Laramie irrigation district	Gering, Nebr.	W. O. Fleenor	Superintendent	C. G. Klingman	Gering.
Fort Laramie division [4]	Goshen irrigation district	Torrington, Wyo.	Floyd M. Roush	Superintendent	Mary E. Harrach	Torrington.
Northport division [4]	Northport irrigation district	Northport, Nebr.	Mark Iddings	Manager	Mabel J. Thompson	Bridgeport.
Ogden River	Ogden River, W. U. A.	Ogden, Utah	David A. Scott	Superintendent	Wm. P. Stephens	Ogden, Utah.
Okanogan [1]	Okanogan irrigation district	Okanogan, Wash.	Nelson D. Thorp	Manager	Nelson D. Thorp	Okanogan.
Salt Lake Basin (Echo Res.) [3]	Weber River Water Users' Assn.	Ogden, Utah	D. D. Harris	Manager	D. D. Harris	Layton.
Salt River [2]	Salt River Valley W. U. A.	Phoenix, Ariz.	H. J. Lawson	Superintendent	F. C. Henshaw	Phoenix.
Shoshone: Garland division [4]	Shoshone irrigation district	Powell, Wyo.	Paul Nelson	Acting irri. supt.	R. J. Schwendiman	Powell.
Frannie division [4]	Deaver irrigation district	Deaver, Wyo.	Floyd Lucas	Manager	Harry Barrows	Deaver.
Strawberry Valley	Strawberry Water Users' Assn.	Payson, Utah	S. W. Grotegut	President	E. G. Breeze	Payson.
Sun River: Fort Shaw division [4]	Fort Shaw irrigation district	Fort Shaw, Mont.	C. L. Bailey	Manager	C. L. Bailey	Fort Shaw.
Greenfields division [4]	Greenfields irrigation district	Fairfield, Mont.	A. W. Walker	Manager	H. P. Wangen	Fairfield
Umatilla: East division [1]	Hermiston irrigation district	Hermiston, Oreg.	E. D. Martin	Manager	Enos D. Martin	Hermiston.
West division [1]	West Extension irrigation district	Irrigon, Oreg.	A. C. Houghton	Manager	A. C. Houghton	Irrigon.
Uncompahgre [3]	Uncompahgre Valley W. U. A.	Montrose, Colo.	Jesse R. Thompson	Manager	H. D. Galloway	Montrose.
Yakima, Kittitas division [1]	Kittitas reclamation district	Ellensburg, Wash.	V. W. Russell	Manager	G. L. Sterling	Ellensburg.

[1] B. E. Stoutemyer, district counsel, Portland, Oreg.
[2] R. J. Coffey, district counsel, Los Angeles, Calif.
[3] J. R. Alexander, district counsel, Salt Lake City, Utah.
[4] W. J. Burke, district counsel, Billings, Mont.

Important investigations in progress

Project	Office	In charge of—	Title
Colorado River Basin, sec. 15	Denver, Colo.	E. B. Debler and P. J. Preston	Senior engineers.
Boise-Weiser-Payette	Boise, Idaho	Lester C. Walker	Engineer
Kenton and Fort Supply	Denver, Colo.	A. N. Thompson	Engineer.
Black Hills	Denver, Colo.	Denver Office	
Eastern Slope (Colo.)	Denver, Colo.	A. N. Thompson	Engineer.
Salt Lake Basin	Provo, Utah	E. O. Larson	Construction engineer.
Marias	Shelby, Mont.	Fred H. Nichols	Associate engineer.
Bear River Surveys	Salt Lake City, Utah	E. G. Nielsen	Associate engineer.

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PEAS IN SHOCK—ALFALFA STACKS IN BACKGROUND, SHOSHONE PROJECT, WYOMING

THE RECLAMATION ERA

DECEMBER 1938

MOUNT SHASTA. MELTING SNOWS MEET SHASTA RESERVOIR, CENTRAL VALLEY PROJECT, CALIFORNIA

Secretary Ickes' Estimate of Federal Reclamation

THE HON. HAROLD L. ICKES in October for the first time was the guest of several Federal Reclamation projects while on an inspection trip in the West. Upon his return to Washington, where the Secretary is the authoritative spokesman on Reclamation policy, Mr. Ickes was questioned by representatives of the Washington corps of press correspondents concerning the work and the projects of the Bureau.

What the Secretary said is of interest to all who are interested in Federal Reclamation.

Concerning his reactions to his trip, Secretary Ickes said, "I think more of the Reclamation Service than ever. They are doing a wonderful job out there; a fine, efficient group of people. Wherever you find anybody who has ever had anything to do with reclamation, he thinks the Bureau is a fine organization; and deservedly so. I do not believe that the people of the country have any comprehension of what is being done in the way of significant public works in the West through the Reclamation program."

Concerning the future of Federal Reclamation, the Secretary said, "I believe for years to come we will be bringing in new land by developing irrigation water for it. Of course, there is a definite ultimate limit for irrigation development, but there is always going to be a demand for more land where fertile land is available and where it is possible to get water to it. Under irrigation you do not have to gamble on the weather. Necessarily, we can't undertake very much more new work at this time until we have completed or more nearly completed what we now have under way. There are some very big projects just starting."

With respect to repayment of project costs, Secretary Ickes said, "I am completely convinced that these projects will eventually pay out, especially where they have power in connection with irrigation."

With regard to the agricultural practices of the Federal Reclamation projects, the Secretary said, "They aren't going to raise corn and wheat and oats on irrigation projects. Down in the Imperial Valley and around Yuma, for example, they raise some long-staple cotton, but it is a very long staple. They raise dates and citrus fruits. They aren't competing with the so-called dirt farmer in other regions; they raise winter vegetables. I saw peas in the fields just coming up in October. Now, those peas will be coming into the eastern market for Christmas and New Year's, and lettuce will be coming from that area into the eastern market for Christmas and New Year's . . . That sort of thing does not interfere with production elsewhere. These irrigated crops are specialized crops, and I do not think they will add to surpluses."

PRICE ONE DOLLAR A YEAR

THE RECLAMATION ERA

VOLUME 28 • DECEMBER 1938 • NUMBER 12

The Federal Reclamation Program

By JOHN C. PAGE, *Commissioner of Reclamation*[1]

THE Federal Reclamation program was launched by the act of June 17, 1902, as a means of providing homes and new opportunities through the development of the arid West by the construction of self-liquidating irrigation projects.

Several factors influenced the adoption of the program. One was that the arid western third of the United States could not be made to support a considerable population without irrigation. Another was that private and cooperative enterprises, by 1902, were finding it increasingly difficult to finance new irrigation projects, and were not prepared to undertake the larger and more costly developments which were required.

Demand existed then, and it is even greater now, for the new opportunities made available by construction of well-planned projects to conserve and use the meager water supply of the West in irrigation of its arid soils.

Since 1902, the Bureau of Reclamation has constructed 147 dams for the storage and diversion of water; it has built about 20,000 miles of canals, ditches, and drains, and a multitude of small structures. It has created reservoirs of a combined capacity of the tremendous total of 45,522,970 acre-feet of water, sufficient to cover the State of Nevada to a depth of 6 inches. It has built 24 power plants on 13 projects where last year 2½ billions of kilowatt-hours of energy were generated.

These are among the physical improvements which have resulted from the Reclamation program. We are proud of them, because we believe the construction record is good. Never has a dam built by the Bureau of Reclamation failed. Its canals and structures have served well.

Results of Reclamation

I do not ask that the Reclamation program be judged by the construction results. To do so would be tantamount to saying that a university should be assigned a scholastic rating based on the number and size of its buildings and the amount of reinforced concrete and marble which had gone into their construction.

The irrigation works of a Federal Reclamation project, like the plant and apparatus of a college, are accessories. If good, they may contribute to success, but the significance of the institution cannot be found in them.

The significance of the Federal Reclamation program lies in the fact that more than 3,000,000 acres which were desert a few years ago now are being successfully farmed because of this construction: that these irrigated lands support on farms and in towns established among the farms nearly 900,000 persons, who have built for themselves 863 schools and 1,076 churches and who are served by banks with deposits aggregating about 200 millions of dollars. The significance of this work also is to be found in the fact that in the 16 Western States where projects now are operating, project lands are assessed for taxation at over 200 millions of dollars. Generally in these States the assessed value represents about half the actual value. These projects obviously, therefore, make a tremendous contribution to the economic and social welfare of the States in which they exist. They provide taxable wealth on the oases in the desert. They knit together sprawling commonwealths.

Last year, 1938, crops produced on these projects had a value of more than $118,650,000. The 1938 production will bring to more than 2½ billions of dollars the cumulative value of crops produced on these projects since they first began operating in 1906.

In other words, these projects are pouring each year into the channels of trade more than $100,000,000, which is about half of their entire cost. Most of the money received by these farmers goes to the great industrial centers of the East and Midwest, for farm machinery, automobiles, clothing, shoes, and manufactured foods. As markets, these projects represent a greater dollar and cents value to our manufacturers than was provided by our exports to the great nation of Brazil in 1928, when our foreign trade was near the peak, and twice that provided by our exports to Sweden in the same year.

The social and economic value to the Nation, therefore, of this program, without the slightest doubt, far outweighs the small concession which the United States makes when it advances the money for construction to be repaid in 40 years without interest.

The Federal Reclamation program has proved itself. It is an active, beneficial policy. Its value in the future is likely to be magnified, for the projects are permanent improvements.

At this time we are engaged in our largest construction program, a program involving works to irrigate an additional 2,500,000 acres of carefully selected arid land, and to provide homes and opportunities for an additional 750,000 or 800,000 persons.

Projects Under Way

The projects now under construction, moreover, include several which will provide a seriously needed supplemental water supply for western irrigated areas already developed, but handicapped by inadequate or unreliable water supplies. These projects include another 2,500,000 acres, among them some of the most valuable and important farm and orchard areas in the West; all of them originally developed by private or cooperative enterprise under State laws. The stabilizing influence of the remedial works will mean substantially as much to the States and to the Nation as would the construction of new projects.

About $300,000,000 has been expended in this construction since 1932 but the new projects have not as yet begun production. As much more will be needed to complete the work now under way.

All of these expenditures are reimbursable. Water users and the purchasers of power, which can be produced at many of our dams simply by dropping water needed for irrigation through turbines, are expected to repay the bill in full.

Past experience indicates that this expectation is not ill-founded. About $250,000,000 has been expended for projects now operating. Collections from water users made

[1] Address delivered November 16 before the convention of the Association of Land-Grant Colleges and Universities at Chicago, Ill.

Bureau of Reclamation Conference at Boulder City, Nevada October 15–17, 1938

Left to right, first row: I. C. Harris, L. N. McClellan, H. W. Bashore, Wm. F. Kubach, L. J. Foster, S. O. Harper, J. K. Cheadl
John C. Page, R. F. Walter, George O. Sanford, F. A. Banks, Miss Mary E. Gallagher

Second row: Mrs. Kemp, W. F. Kemp, Mrs. Davis, L. S. Davis, H. D. Comstock, D. J. Paul, E. O. Larson, C. C. Fisher, D. L. Carmod
E. A. Moritz, C. C. Ketchum, Mrs. Hayden, H. W. Johnson, E. C. Koppen

Third row: S. E. Hutton, Stanley Marean, V. W. Russell, Mrs. Marean, Mrs. Youngblutt, F. C. Youngblutt, H. H. Johnson, H.
Parker, J. R. Alexander, Mrs. Alexander, Miss Alexander, Mrs. Gleason, C. F. Gleason, J. S. Moore, Dana Templin, B. E. Hayde
W. E. Warne, Charles E. Crownover

Back row: R. C. E. Weber, L. E. Foster, L. R. Fiock, E. W. Shepard, T. J. Madden, R. J. Newell, P. A. Jones, H. P. Bunge
G. Bloodgood, H. V. Hubbell, L. J. Windle, W. J. Chiesman, G. A. Bonnet, L. R. Douglass, H. J. S. Devries, A. W. Walker, T.
Mead, George Snow, C. B. Elliott, S. L. Baird, L. R. Smith, P. J. Preston

by the Bureau of Reclamation total more than $115,000,000, of which about $50,000,000 has been construction repayments. Delinquencies in payments are small. There is no use hiding facts, and I will not dissemble. There have been some write-offs in the past to correct mistakes. These mistakes were not engineering mistakes, but rather were the result of pioneering in a new field. These adjustments have amounted to about $17,000,000.

Irrigated Agriculture

I believe this is a fairly accurate outline of the Federal Reclamation program. It is against this background of facts and figures that I want to discuss the agriculture of the Federal Reclamation projects.

The agriculture of irrigated lands, although the crops may be somewhat different, is subject to all the influences exerted upon agriculture generally by market and economic conditions. Sometimes this fact has been overlooked by critics of reclamation. The ills of agriculture in the humid regions attack that of the irrigation projects in precisely the same manner. Farmers everywhere in the United States were having great difficulty in meeting their bills a few years ago. The Federal Reclamation projects were no exceptions, but the farmers on these projects certainly were not alone in their plight. Public attention during those trying times was directed toward areas where farmers were taking direct action as their means of protesting against unendurable conditions. There was no violence that I recall on any Federal project, but because settlers on Federal irrigation projects sought and obtained moratoria on their construction repayments during the most critical years, some seem to feel that something was wrong with the Federal Reclamation policy. To reach this conclusion requires a very broad jump indeed. It requires a leap clear over the difficulties of agriculture which for years have monopolized so much of the attention of the Department of Agriculture.

Aside from general conditions affecting all, certain factors work to the advantage of the irrigation farmer, and certain others work against him. He is not, ordinarily, completely at the mercy of the weather for crop production. This is his advantage over the farmer in the humid regions. He does, however, have to pay for his water and for the task of getting his water to his land. Here he is at a disadvantage. Offsetting this is the fact that due to his control over his water supply and the necessity to farm carefully and more intensively on smaller farm units, the irrigation farmer's gross return per acre averages ½ times that of the farmer the Nation over. Because he buys his water, thus adding from $2 to $5 per acre per year to his operating expense, his net return is more nearly comparable to that of other farmers. Crops on irrigation projects may be wiped out by a plague of grasshoppers, a hailstorm, a poor market, low prices for his product, and any of the other ills, except for the most part drought, which afflict our agriculture.

Irrigated Agriculture Specialized

The work of farming on land which must be irrigated is far more specialized than that of the farmer on land in humid sections. The irrigation farmer must have added skill. He must be a good irrigator to get the best results from his land. One is not born with this ability; he must acquire it. It is difficult and delicate work. The problem is to get just enough and not too much water, evenly spread upon the land at the right time to do the crop the most good. The problem is different for different soils and for different crops. The average ability of American irrigators is very low. There is much to be learned. Improved methods and practices are being developed, and the State universities are far ahead of the average irrigation farmer, but their knowledge is being spread over the irrigated fields of the West all too slowly.

In some areas farmers are leaching their soils by overirrigation; in others they are waterlogging their neighbor's farm by poor practices; in nearly all they are using too much water, which makes their operations cost them more than necessary, and which, in addition, further curtails unnecessarily the already severely limited areas which can be made productive in the West.

Let us look for a moment at the West; at that part of the United States which some geographers used to describe as the "Great American Desert." Twelve million people now live there, thanks largely to irrigation. It is 700,000,000 acres in extent. From the 100th meridian to the Pacific Ocean, except for high mountains and a strip lying along the coast from San Francisco northward, the average annual rainfall ranges between 3 inches to about 20 inches. Only by irrigation can a safe agriculture be made to flourish there.

Project Feasibility

At present about 20 millions of these 700 millions of acres are irrigated by private, cooperative, State, and Federal projects. The Federal Government now is building works to irrigate 2½ millions more, which will leave, according to the calculations of the Bureau of Reclamation, about 7½ millions of acres which, apparently, it may be feasible to irrigate in the future. A feasible project, by our standards, is one where there would be a reasonable expectation that the water users could repay the construction costs in 40 years. This presupposes a reliable water supply, good lands, and no insuperable engineering difficulties. The potentialities, as can readily be seen, are circumscribed. These facts emphasize the importance of careful planning for the future.

I have heard some expostulate that irrigated agriculture is not permanent, but I have been unable to find any clear historical basis for this statement. Our oldest civilizations, in Egypt and China and India, are founded, in large part, on irrigation agriculture. We have within the territorial boundaries of the United States some farms which have been irrigated for more than 300 years. They are served by canals built by the Spanish when they first entered the Southwest. Judging by the results of investigations in the Piedmont and in many other humid sections, it is my opinion that farming by irrigation in the arid States, for the most part, may be our most nearly permanent agriculture.

In any event, except where soil conditions were not adequately investigated at the outset, there seems to be no reason to believe that our western irrigation projects, private, cooperative, or Federal, will not live and produce for many generations to come.

Some criticism has been heard from those who believe they detect a conflict between policies in the fact that irrigation projects are being built while submarginal lands are being retired in other areas, and from those who fear that the produce on western irrigated land will flood markets upon which farmers in the Midwest, South, and East rely.

The facts will not justify these fears nor the criticism based upon them. The facts all point the other way.

About 9,000,000 acres of submarginal land, 2,000,000 acres of it in scraggly crops, have been retired by the purchase program of the Department of Agriculture. These acres are those which were returning to the farmers who toiled on them only poverty for their efforts.

The best figures I can obtain indicate that about 200,000 people have migrated to California in search of new homes and new opportunities in 5 years. We know that at least 50,000 farm families have fled the Great Plains in that time, most of them going to Idaho, Oregon, Washington, and California. These great shifts in population have not yet been halted. The irrigation States have a terrible problem on their hands, and expansion of the irrigated areas is the most obvious and the best method of permanent solution. All the projects we now have under construction, if completed today, would take care of only a fraction of these unfortunate victims of drought, erosion, and mechanization.

As for competition between the products of irrigated land and those of farms in humid areas in markets from the Mississippi Valley eastward, one has only to look at the map to understand the most potent reason why this competition cannot exist.

These irrigation projects lie from nearly 1,000 to about 2,000 miles distant from Chicago, and they are correspondingly farther removed from markets to the east. Freight tariffs are just as real as any other kind of tariff, and freight rates certainly operate as a tariff to protect the middlewestern,

southern, and eastern farmer from the competition of his western brother.

Agriculture of Irrigation Projects Complements That of Other Sections

The agriculture of the irrigation projects, for the most part, is complementary rather than competitive with that of other sections.

No tobacco is grown in the West. Cotton is a major crop in only a scattered few irrigated sections, and in some of these the production is confined to long-staple varieties. Corn and wheat are produced only very sparingly on irrigated land, irrigation water costs too much to make it profitable to grow them. The Pacific Coast cities obtain most of their pork and pork products from the Mississippi Valley. Many irrigation projects do not produce sufficient wheat for the needs on the farms. When the 1,200,000 acres to be irrigated by Grand Coulee Dam are watered and fully developed, the wheat-producing acreage of the West will actually be reduced by about half a million acres. At present about 500,000 acres of these lands are dry-farmed and wheat is the crop raised. When irrigated and fully developed this land will be put to other uses.

If no competition exists in these big, staple crops, where exportable surpluses have existed, then where could crop competition enter? The western projects produce a great variety of crops. Nearly every project has a specialty crop, or several of them, which are grown for cash return to the farmers.

The livestock industry is the West's largest. It depends upon the public pastures for half its forage. The other half is provided by the 20,000,000 acres of irrigated land. Cattle and sheep for the feed pens of the Midwest are supplied largely by western ranches. This is one of the many complementary relationships.

Sugar beets are the cash crop of many irrigated regions in the mountain States. Much of our sugar is imported.

Citrus fruits are a major crop on areas in California and Arizona. California oranges are shipped around the world.

Truck-gardening is one of the largest enterprises of many of the southwestern projects. Literally tens of thousands of carloads of lettuce and cantaloupes and other winter vegetables are shipped to markets thousands of miles distant from these projects. I was in the Imperial Valley last month, and saw many fields of lettuce just coming up. The lettuce will be harvested about Christmas time. It certainly will not push off the counters in Chicago stores any lettuce produced by truck farmers in Illinois, Indiana, or Wisconsin. If lettuce could be produced nearer at hand at Christmas, the farmers in the Imperial Valley could not afford to ship their stuff to Chicago. It is expensive, this business of shipping lettuce by express-freight in iced cars half across the continent. It is not so expensive, however, that the housewife of Chicago cannot have lettuce in the dead of winter for the salads she prepares for her children.

The summer bill of fare for the average family a few years ago included fresh fruits and vegetables; the winter menu did not. Now, thanks largely to the western irrigated lands, the summer bill of fare is good the year around.

Where, then is the competition between the agriculture of humid regions and that of the irrigated lands? The answer is that it does not exist to an appreciable measure.

The farmers of the Mississippi Valley and other areas, who serve industrial centers, are benefited by western irrigation in another way. The irrigation farmer buys the product of midwestern and eastern factories, and thus creates market for the nearby farmer who feeds the industrial laborer.

Go back to the time in the middle of the last century when the homestead laws were being debated in the Congress of the United States. The farmers of New York and Pennsylvania were arguing, and their city folk joined in, that to open more Mississippi Valley lands to free settlement meant additional competition and eventual ruin for them. But has that been the result? It certainly has not. The older sections of the country benefited greatly by the new development which followed the passage of the homestead laws. It was natural that they should.

The arguments that expansion of irrigation in the West will hurt any other section are as specious today as were the arguments made so long ago against settlement and development of this middle area.

Reclamation a National Policy

I should like to call to the attention of the land-grant colleges that reclamation has been an accepted national policy for 36 years; that farming by irrigation is the major interest of the agriculturists in one third of our country and a major support of States with population totaling 12 millions.

It is true that irrigation is not practiced in two-thirds of our country, but I do not consider that sufficient reason for a grievous lack of interest in irrigation and knowledge about it—east of the 100th meridian. It may not be necessary to teach irrigation practices to students in colleges of agriculture situated in States with humid climates, but every student seeking an education in a college of agriculture anywhere in the United States has a right to be generally informed concerning various agricultural practices from coast to coast. Many have not been given an opportunity to learn the things which are necessary to dispel sectionalism in approaching this vital question of irrigation.

I should like to call to the attention of those of you from the West that one of the primary results of Federal Reclamation is the development of Western States. It has seemed to me, and I believe that Dr. Charles A. Lory, president of Colorado State College, who was a member of a special commission which studied some of the problems of the settlers on Government irrigation projects last year, will agree. It has seemed to me that the Western States and western colleges have left the Federal projects to their own devices. They have not extended the help to the settlers which has been needed, and which has been warranted by the importance to the States of these projects.

When we open a new project for settlement, it is important that the new water users be given adequate guidance in the use of their soil and water. The State colleges, through their extension services, could render these people, their State, and the Nation a valuable service by assisting them in making the right kind of a beginning. Here is a good, practical point at which to start Federal-State cooperation in an endeavor which clearly benefits both.

This service could be extended, with continuing advantages to all concerned, down through the development of the projects, through demonstrations of adaptable crops, weed control and along many other lines.

No criticism of present programs is intended. I wish merely to suggest for your consideration a place where help might be given.

I am a proponent of Federal Reclamation, but I have tried to present a fair discussion of our program, its objectives, and its results. I have never found an opponent of Federal Reclamation, who after fully informing himself, failed to lend his support to the program.

Yakima Sugar Beets

A BUMPER CROP of sugar beets, estimated at 220,000 tons, was reported at the close of October as being harvested on 14,200 acres in the Yakima Valley. Although the Toppenish refinery of the Utah-Idaho Sugar Co. was being operated beyond its rated capacity of 1,600 tons a day, it was believed it would be necessary to ship about 30,000 tons to the company's Bellingham plant for refining. Company officials consider the crop grown in the Yakima Valley the "greatest crop of beets in the West."

Klamath Potatoes

HARVESTING of the potato crop on the Klamath project has been completed. The quality was about average, the yield above expectations, and all project storage is filled to capacity. It is expected that more than 9,000 cars will be shipped from the project this year.

Enlargement of the Marshall Ford Dam

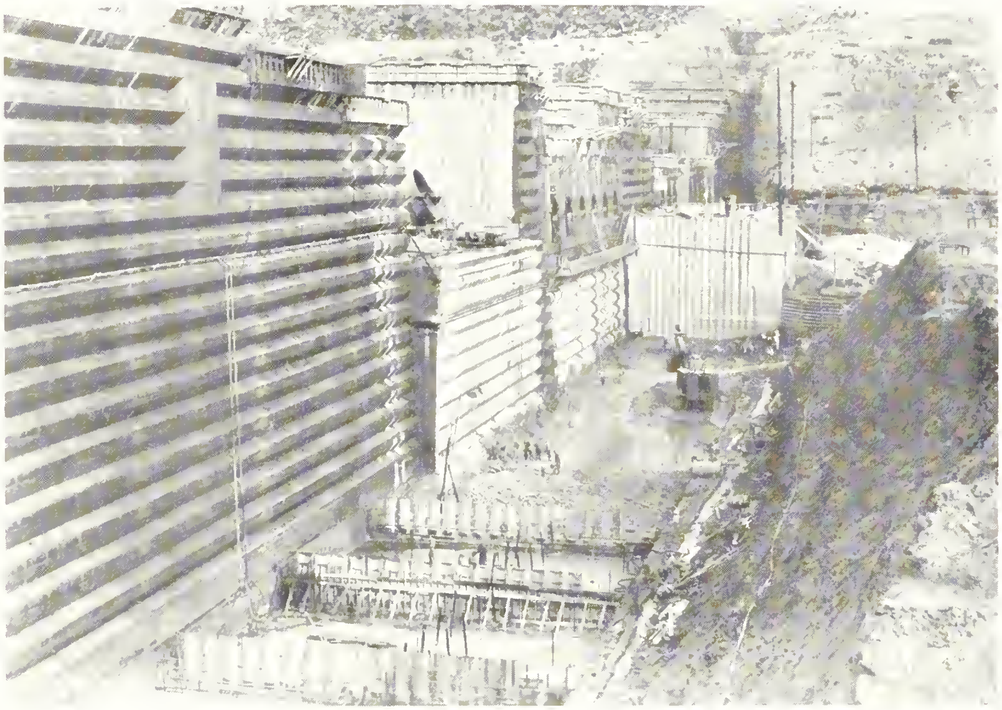
By E. H. HEINEMANN, *Assistant Engineer*

DESPITE a late July flood of the Colorado River of Texas which delayed large-scale concrete placing operations for several weeks, the end of September saw the initial development of the Marshall Ford Dam well on its way to completion. Of an estimated 969,000 cubic yards of concrete 656,336, or nearly 68 percent, had been placed by the first of October. Parts of 20 of the 24 paradox service gates were embedded in the concrete and the three 16-foot diameter penstocks had been placed to final position. The greater part of the spillway training walls had been completed and the downstream cofferdam had just been removed, allowing the completed spillway apron to be flooded.

Like Grand Coulee, the Marshall Ford Dam is being constructed in two stages. However, in this case the division is in a vertical plane rather than in a horizontal plane as in the former. The 190-foot dam will be increased in height by the addition of a section 58 feet thick and 268 feet high to the upstream face. Horizontal keyways provided in the intial development for tying in the fresh concrete may be seen in the accompanying photograph. The increase of 78 feet in the height of the dam will increase the capacity of the reservoir from 600,000 acre feet at spillway crest of the low dam to 2,000,000 at spillway crest of the high dam.

Since present appropriations do not cover the entire development, as now planned a base for the high dam is being built to elevation 520 (foundation at elevation 483+) in 28 blocks across the river portion. On October 5, the first of 120,000 cubic yards of concrete for this base was placed. The accompanying photograph shows excavation and construction of concrete forms for the dam enlargement in progress at the upstream face of the low dam. Aside from concrete, quantities of major construction items for the high dam base are as follows: Reinforcement bars, 600,000 pounds; standard metal pipe, 203,000 pounds; trashrack metal work, 1,700,000 pounds; common excavation, 71,000 cubic yards; rock excavation, 34,000 cubic yards. Construction of the dam enlargement also provides for artificial cooling of the mass concrete, a feature first tried on a large scale with success at Owyhee and Boulder Dams but not included in the low dam at Marshall Ford. For this cooling system, 91,000 pounds of metal tubing and fittings will be embedded in the concrete.

Since signing of the contract, subsequent extra work orders and orders for changes have increased the original bid price from $5,781,235 to approximately $7,000,000. That construction is progressing rapidly is evidenced by the contractor's receiving the largest progress payment to date for September's work, $417,386.15. Barring serious floods, the contractor, Brown & Root, Inc., and McKenzie Construction Co., should be done with all its work under present approved plans by the autumn of 1939.



Above: Construction of base for high dam started
Below: Dam approximately 60 percent complete

Construction of the Ephraim Tunnel

By CECIL B. JACOBSON, *Assistant Engineer*

THE Sanpete Valley in central Utah is rather unusually situated, with its small farming communities near an extensive forest area of nearly 1,000,000 acres of grazing lands which is claimed to support the largest number of sheep and have more individual grazing permits per square mile than any other forest area in the United States.

The necessity for establishing a balance between this range land and the farm lands has brought about the constant demand for additional irrigation water. The completion of the Ephraim Tunnel marks an important advancement towards supplementing the present meager water supply for the farming community near Ephraim, and will assure the production of ample winter feed, the lack which has been the basis of many individual economic upsets and failures within this potentially prosperous area, which is internationally known for its purebred Rambouillet sheep.

The Ephraim Tunnel, through a system of feeder canals, makes possible the transmountain diversion of 4,400 acre-feet of water originating on an adjacent high watershed tributary to the Colorado River. The tunnel, some 7,113 feet in length and having a capacity of 95 second-feet, is located 15 miles east of Ephraim at an elevation of 9,800 feet above sea level and 3,800 feet above the floor of the valley. A steep, unimproved mountain road, leading from Ephraim, the nearest town providing railroad facilities, to the tunnel site, made the transportation of materials and supplies a difficult problem, especially under the severe weather conditions prevailing at such a high altitude.

Competitive bids for the construction of a 6½-foot diameter horseshoe-shaped tunnel were received on July 8, 1935, and a contract awarded on August 15, 1935, to the Morrison-Knudson Co. of Boise, Idaho, on their low bid of $162,434. The contractor established his camp at the outlet end of the tunnel and started excavating at that heading.

Activities were suspended on January 30, 1936, owing to heavy snow conditions, and resumed on May 28, 1936. Excavation was started at the inlet end on July 15, and driving was continued from both headings until the tunnel was holed through on November 22, 1936, after a working period of approximately 11 months. Unforeseen conditions which prevented the delivery of materials to the tunnel site brought about an equitable release of the contractor, and the taking over of the work by the Government. The contract was subsequently terminated by a special order on February 15, 1937. The condition of the tunnel at this time, however, was such that it permitted the diversion of the following spring run-off.

Tunnel Excavation

Most of the excavation was accomplished from the outlet end of the tunnel by using two diesel-powered compressors and a gasoline-powered blower in the driving operations. Mine cars, drawn by a storage battery locomotive, were loaded by a small compressed-air mucking machine. At the inlet end the cars were loaded by hand and drawn by a horse. Considerable difficulty was experienced in the driving of the first 1,500 feet of the tunnel, due to the use of 24-inch gage track and equipment in the small 6½-foot bore. This crowded condition was remedied by installing 18-inch gage track and equipment, making possible the switching of equipment without excessive excavation in the tunnel walls. At this time the use of 15-inch diameter flexible canvas ventilating tubing was abandoned and replaced by a 12- to 14-inch diameter galvanized iron ventilating line.

The entire tunnel was driven through limestone and shale members of varying thicknesses and qualities. The limestone encountered was mainly of good quality, being hard, tight, and resistant to deterioration. The shale was somewhat unstable and slacked when exposed to air and moisture. The total overbreakage in excavation amounted to 11 percent for the entire tunnel. The excessive amounts occurred in one badly fractured fault zone and also at places where thin beds of limestone and shales were found in the upper reaches of the heading. These layers broke in rectangular blocks, making it impossible to form the arch section. The small quantity of water encountered caused no serious problem. An average daily progress of 18 linear feet, or 23.4 cubic yards of excavation, was made for the entire time the excavation operations in the tunnel were in progress.

A thorough inspection was made throughout the tunnel after the first year's operation, resulting in a recommendation to line certain additional reaches with concrete or permanent timbering as a protection against further sloughing. Permanent timbering was installed at various sections for a total distance of 1,335 linear feet, or 18.8 percent of the tunnel length, by Government forces in the fall of 1937, and it was anticipated that some additional supports would be necessary in the future. The timbering, all of which was treated with creosote, was constructed of sets made of 6- by 6-inch vertical posts and 3-segment arch sections spaced at 5-foot 4-inch centers. These sets supported 2-inch lagging, all of which was placed in the arch section.

The contractor, prior to the termination o his contract, had concrete-lined 398 linear fee of tunnel in the vicinity of the fault zon by operating from both portals. The temper ature of the mix was controlled by heatin the mixing water to 180° F. Mine cars loade with 3 one-sack batches, each separated b canvas partitions to prevent segregation, wer used to transport the mix from the portals t the forms. A horse was used to draw th cars a distance of approximately one-hal mile from the inlet portal, the trip requirin 25 to 30 minutes from the time of loading t the time of placing in the forms. The ca carrying the concrete mixed at the outl portal were drawn by a storage battery loc motive, the haul being about 1½ miles an requiring about 25 minutes from the time o loading to the time of placing in the form The temperature of the mix when placed i the forms was about 56° F.

The concrete hauled from the inlet hea ing was placed by hand. Forms construct in panels were utilized in placing the side and the arch. The concrete was shovele into the sides and the upper panels installe after the lower forms were filled. Compac ing was done with hand tampers and shovel The concrete in the top was rammed bac over panels of short length with a hoe an worked in the roof with a loading stick. Thi process was rather slow and required about 1 hours to place a 21-foot section.

The concrete transported from the we heading was placed with the use of a pneu matic concrete gun. Forms were built u complete excepting the top center pane which were left out to provide inspectio openings. Batches of ½-cubic yard of co crete were placed in the concrete gun an shot in at the top of the forms through 4-inch discharge pipe, the end of which wa kept 5 feet from the face of the concret and alternated from one side to the othe to keep the concrete at the same level o both sides as the lining progressed. A slum of 4 inches was maintained at the point o placement. Placement was started by usin a batch of grout in each side as a means o preventing segregation. Owing to the fa that the concrete lining at certain poin had a minimum thickness of 3 inches, it wa found impossible to use a mechanical v brator behind the concrete forms, necessita ing the use of long handled hoes and rods t work the concrete in the forms. From 2 to 30 linear feet of lining was placed in a 8-hour shift, the quantity being largely d pendent on the amount of over-breakag which in some cases resulted in a thicknes of lining of 10 to 12 inches, compared to

nominal thickness of 6 inches. The invert was placed last and was hand-tamped and screeded from shoulders cast integrally with the sides. The concrete was slow in acquiring its initial set, due to the low temperature of 44° F. in the tunnel. In general, the lining had a smooth dense finish and only a small amount of patching was necessary. The results obtained in the lining placed by the concrete gun were slightly better than that placed by hand, a marked difference occurring in the arch section. In placing the tunnel lining the contractor's daily progress averaged 22 linear feet or 8.5 cubic yards.

Concrete was also placed in the portals, headwalls and tunnel lining by Government forces, the lining amounting to 428 linear feet. The method of concrete lining was somewhat similar to the hand placement performed by the contractor. However, a metal-faced form of a different type was devised which greatly aided the placing operations. Side panels made up in 12-foot lengths by 2 feet wide, were erected and held in place by spreaders and tie wires attached to dowels driven in the rock walls behind the forms, eliminating the use of lateral bracing and making it possible for men to work at the immediate point of placement. As a result, the concrete could be placed and compacted in 6-inch layers. A short section of the invert was placed ahead of the sides and arch. It was, however, found advantageous to place the invert last because of the added head room which greatly facilitates operations in such a small tunnel bore. The metal faced forms were responsible for an unusually smooth finish and the concrete was found to be of higa quality. During the lining operations with Government forces the average daily progress was 30 linear feet or 12.4 cubic yards.

Valuable assistance was rendered to the project during the progress of the work by CCC forces. This group established a camp on the mountain near the tunnel site and was engaged in the construction of the feeder canal system. Other assistance consisted of building roads, construction of the Government camp, and the hauling of materials which were used by Government forces in the tunnel lining operations.

The Spring City Tunnel is now under construction and will probably be completed prior to the irrigation season of 1939. The completion of the two tunnels, and feeder canal systems, should prove to be of considerable assistance in solving many of the problems of this area and place it in the ranks of the numerous successful Bureau of Reclamation projects.

Rural Electrification on Salt River Project

By H. J. LAWSON

Chief Engineer, Salt River Valley Water Users' Association

SINCE the latter part of 1929 every farm home on the Salt River project has had electricity available, and in 1938, as nearly as can be determined, approximately 98 percent of these farm homes are connected to the power lines of the project, and are enjoying the advantages of electric power service. Only shacks and tents of the very poorest kind are not served with electricity.

Since November 1, 1917, the Salt River Valley Water Users' Association, a great cooperative composed of the landowners of the project, has operated the Salt River project which was the first large Federal reclamation project. Since the Government turned over the project to the landowners to operate and maintain, the association has spent some $19,000,000 on power development and now has eight water plants totaling 105,500 horsepower capacity and a Diesel standby plant of 14,000 horsepower capacity with contracts providing varying amounts of steam standby from customers' plants.

The power users consist mostly of mines, municipalities, power companies, factories, and farms. The farm load for pumping for irrigation in areas not included in the Salt River project is large and amounts to nearly 30,000 kilowatts. The use of electricity for domestic and general farm uses is practically universal on the Salt River project and brings most of the conveniences of city life to the farm. Rates for electricity on the farms with an average of about five customers per mile compare favorably with rates in most cities of the United States and in consequence the average annual use per rural customer in 1937 was 1,840 kilowatt-hours.

Electricity on the farm in the Salt River project is specially advantageous, owing to climatic conditions. Electricity has made possible summer comfort in homes at low cost. Nearly every farm home has its desert type of air cooler which costs but little to install, operates for a few dollars per month, and is amazingly effective in this dry climate. The electric range and refrigerator are especially valuable in a hot climate.

The association's power load peaks in the summer months, so it is feasible to supply winter loads without additional investment in generating, transmission, and distribution capacity. Therefore, in order to bring to its people a further advantage of electricity, the association has made a special rate of 1 cent per kilowatt-hour for house and water heating. At this rate it is feasible to heat well-constructed houses at reasonable cost due in a great measure to the mild winter climate. There are a considerable number of homes so heated electrically and the average cost runs about $60 for the 5 months' heating season. The advantages are real and many and it is expected this use of electricity on the Salt River project will increase greatly. Water heating for ordinary farm home requirements at the 1 cent per kilowatt-hour rate costs only $2 to $3 per month.

At the end of 1937 there were 5,815 rural customers on the association's lines. Use of power by rural customers was 10,161,745 kilowatt-hours during the year, bringing a gross revenue of $356,844.42.

The Salt River project did for itself in 1929, through its cooperative Water Users' Association, what the REA is now doing for farmers throughout the United States.

Migratory Fish Consultants

SECRETARY of the Interior Ickes has appointed Dr. W. F. Durand, and Dr. Willis H. Rich, of Palo Alto, Calif., and Dr. Robert D. Calkins, of Berkeley, Calif., as consultants to investigate and report to him on the migratory fish problems on the upper Columbia River, as affected by the construction of Grand Coulee Dam.

This committee of consultants was appointed because the height of the dam would seem to preclude a feasible method of maintaining the natural runs of migratory fish past the dam when completed. However, there are four large tributaries which enter the Columbia River below Grand Coulee Dam, and above the Rock Island Dam of the Puget Sound Power & Light Co. near Wenatchee, namely the Wenatchee, Entiat, Methow, and Okanogan Rivers, and it is evident that these four streams can be made to support a much larger fish population than they do at present.

In general, the plan suggested by the Department of Fisheries of the State of Washington calls for the trapping of the fish at Rock Island Dam and hauling them to a series of holding ponds to be built on Icicle River, a tributary of the Wenatchee River, near the town of Leavenworth, Wash. The fish are to be held in the ponds until spawning time, when the eggs will be taken and hatched at stations to be built near the ponds. The young fish will then be reared to various stages and released in the four streams previously mentioned and thus build up a natural run in those streams to replace the present run past Grand Coulee Dam.

Yuma Auxiliary Grapefruit

DURING October, 15 carloads of packed grapefruit were shipped from the Yuma auxiliary project to the Pacific coast and midwestern markets, and the equivalent of 75.5 carloads of loose and packed fruits were sent by truck to the Pacific coast.

Electrical Development on the Minidoka Project

By DANA TEMPLIN, *Superintendent*

THE Minidoka power plant, located at the Minidoka Dam, Idaho, was completed and put into operation in 1909. Built primarily to supply power for pumping water to the lands of the Burley Irrigation District, comprising some 48,000 acres, it has in addition furnished light and power for the cities and farms of the project. Also, because the pumping stations are shut down in winter, a considerable part of the power developed at the plant was made available for heating purposes, and many residences and public buildings depend entirely on this method of heating.

Since the first delivery of commercial power on the project, there has been a rapid growth in the demand for it, so that in 1937, the amount of power used and the returns from it, exceeded all previous years. A comparison of the figures for the past 10 years, from 1928 to 1937, inclusive, is shown in the table at the foot of this column.

The demand varies from year to year with financial conditions, while in winter the heat load is affected by the weather; a mild winter showing a drop in the amount of energy used. In recent years, however, the demand has been rising steadily and already is approaching the limits of the available supply. Some interesting figures illustrating this growth are seen in the reports for early years, the total sales of electric energy in 1910 being $500, in 1911 $5,000, in 1913 $15,500, and in 1937 they had increased to the substantial total of $163,000.

Distribution of Power

Distribution of the power to the people of the project is accomplished through contracts between the United States and the cities and towns, cooperative rural companies, and individuals. Burley and Rupert are the two largest towns on the project and, of course, the two principal users of electric energy. Both towns derive a substantial profit from the sale of current to their citizens, sufficient to defray a large part of the cost of municipal operation. Following is a statement of the transactions of the two towns for the fiscal year ended April 30, 1938:

Town	Gross receipts	Gross expenditures	Profit
Burley	$133, 960. 00	$95, 904. 58	$38, 055. 42
Rupert	72, 583. 88	42, 702. 56	29, 881. 32

During this period, Burley delivered 5,038,800 kilowatt-hours of electric energy for light and power, which cost about 1 cent per kilowatt-hour, and 5,507,700 kilowatt-hours of electricity used for heating, costing about 1½ mills per kilowatt-hour. In Rupert, 3,232,909 kilowatt-hours were delivered for light and power, at a cost of 1¹⁄₁₀ cents per kilowatt-hour, while 3,239,925 kilowatt-hours were used for heat, the cost for which was 1⁷⁄₁₀ mills per kilowatt-hour. The costs indicated represent the amounts paid the United States and do not include delivery expense.

There are about 20 rural companies, which purchase power from the Government and deliver it to their subscribers. Most of these companies capitalized themselves by the sale of stock, which money was used for building the distribution lines, transformers, etc. Usually power is sold practically at cost, or if any profits accrue, they are distributed to the stockholders or used for betterments.

Government Plant Serves 1,200 Farms

Some 1,200 farms, or approximately one-half of those on the project, now receive electricity from the Government plant. The average delivery to each of these farms is nearly 4,000 kilowatt-hours per annum, or more than 1,100 kilowatt-hours per person. In Rupert and Burley, the average delivery is about 2,540 kilowatt-hours per person. None of the figures quoted so far, includes power used for irrigation pumping, but considering the total amount of power developed and used on the project, the average is nearly 3,500 kilowatt-hours per person per year, as compared with an average of about 900 kilowatt-hours per year in the entire United States.

It is the policy of the Government to encourage consolidation of rural companies wherever practicable, and several of these consolidations have already been accomplished. Such measures not only simplify the dealings between the United States and the companies but reduce operating costs and enable the companies to purchase power in greater quantities and therefore at lower costs, thus increasing profits.

Electrified Farms

It is interesting to note the changes that have occurred in the use of electricity on the farms. At first, lighting of the houses was the main object sought, with perhaps a little power for operating a pump, cream separator, or feed grinder. Today, however, many of these farm homes are as thoroughly equipped as any city dwelling, with electric refrigerators, washing machines, ranges, percolators, and many other appliances. On the farm, too, new uses of various kinds have developed. Several dairies are using milking machines, electrically operated, with great success. There are two egg hatcheries on the project, both of which are operated wholly by electricity. One of these, owned by J. C. Merrill, is near Paul and last spring he hatched 175,000 eggs and sold 90,000 chicks, all to local customers. The other hatchery is near Declo, and is owned by Fred Hansen. Last season, 22,000 eggs were hatched at this establishment and 20,400 chicks were sold.

Increasing Demand for Electricity

This growth in the demand for electricit[y] is already taxing the resources of the Gov[-]ernment's power system. The power plant ha[s] a capacity of 10,000 kilowatts, and in additio[n] through an exchange agreement, large amount[s] of power are obtained from the Idaho Powe[r] Co., both in winter and summer. Last yea[r] Congress appropriated $400,000 to build [a] 5,000-kilowatt extension to the present plan[t]. If this enlargement is constructed, it is hope[d] a portion of its output can be used to mee[t] local needs. As stated previously, about on[e-]half of the farms of the project are no[w] receiving electric service. Surveys have bee[n] made which show that practically all of tho[se] farms now without this service can be supplie[d] without undue difficulty or expense, and [it] is confidently expected that this goal wi[ll] ultimately be reached.

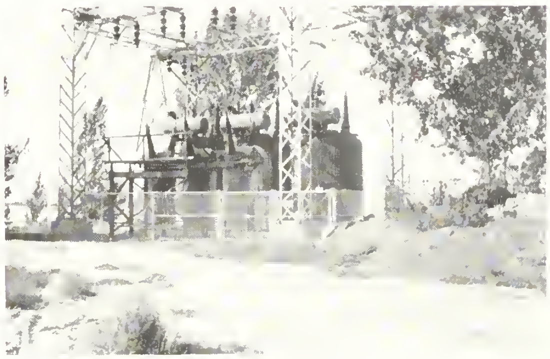
Year	Kilowatt-hours			Income			Total	
	Light and power	Heat	Miscellaneous kilowatt-hours	Light and power	Heat	Miscellaneous income	Kilowatt-hours	Income
1928	8, 876, 415	13, 157, 713	----------	104, 783. 01	25, 434. 97	32. 76	22, 034, 128	130, 250. 74
1929	8, 318, 561	14, 106, 218	1, 428, 806	107, 717. 20	26, 543. 52	5, 125. 27	23, 853, 585	139, 385. 99
1930	9, 016, 589	13, 619, 690	1, 608, 597	117, 353. 25	26, 578. 69	16, 555. 48	24, 244, 876	160, 487. 42
1931	8, 968, 925	12, 429, 826	2, 377, 916	117, 623. 10	24, 491. 65	10, 147. 70	23, 776, 667	152, 262. 45
1932	8, 174, 938	10, 997, 594	3, 691, 486	108, 509. 33	21, 150. 95	19, 375. 61	22, 864, 018	149, 035. 89
1933	7, 227, 052	10, 299, 956	2, 354, 470	97, 693. 06	19, 601. 39	13, 655. 90	19, 881, 478	130, 950. 35
1934	7, 934, 918	8, 909, 637	1, 277, 384	101, 459. 22	17, 428. 98	8, 386. 99	18, 121, 939	127, 275. 19
1935	8, 445, 340	10, 695, 239	2, 506, 126	110, 129. 30	20, 095. 02	19, 591. 04	21, 646, 705	149, 815. 36
1936	9, 963, 319	10, 794, 451	2, 788, 556	117, 952. 87	20, 882. 27	12, 896. 59	23, 546, 326	151, 731. 73
1937	11, 305, 168	11, 090, 685	2, 519, 077	129, 610. 18	21, 406. 06	12, 018. 19	24, 914, 930	163, 034. 43

Minidoka Power House, downstream side

Minidoka Power House, generator floor

Paul Substation

Kitchen of Berger home



Connection with Idaho Power Co.
Minidoka Dam looking south

Craven farm, north of Paul

Berger farm, west of Rupert

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NOTES FOR CONTRACTORS

Specifications No.	Project	Bids opened	Work or material	Low bidder: Name	Low bidder: Address	Bid	Terms	Contract awarded
		1938						*1938*
706	Central Valley, Calif.	Sept. 26	Earthwork, tunnels, and structures, milepost 258.63 to milepost 272.68, Southern Pacific R. R. relocation.	Granfield, Farrar & Carlin	San Francisco, Calif	[1]$812,380.90		Nov. 1
				West Construction Co	Monrovia, Calif	[2]904,981.00		Do.
800	Gila, Ariz.	Oct. 6	Structures, gravity, main canal, stations 30 to 946+70.	Jahn & Bressi Construction Co.	Los Angeles, Calif	388,767.73		Oct. 28
803	Central Valley, Calif.	Oct. 14	Pumping plants nos. 1, 2, 3, and 4, Contra Costa Canal.	George B. Henly Construction Co.	Ontario, Oreg	[1]130,397.00		Nov. 3
1130-D	Rio Grande, N. Mex.-Tex.	Oct. 13	1 dragline excavator, 40-foot boom, and accessory equipment.	Ruth Dredger Manufacturing Corporation.	Los Angeles, Calif	[3]14,500.00	Discount $300	Nov. 7
1122-D	Boulder Canyon, Ariz.-Nev.	Sept. 26	Materials for metal shelving, bins and benches for warehouses nos. 2 and 3.	DeLuxe Metal Furniture Co.	Warren, Pa	3,193.23		Oct. 27
1123-D	Boise-Payette, Idaho	Sept. 28	Structures, D-Line Canal laterals 18.7 to 24.3.	David A. Richardson	Caldwell, Idaho	18,544.50		Do.
1127-D	Colorado-Big Thompson, Colo.	Oct. 5	Transformers, oil circuit breakers, disconnecting switches, and lighting arrester.[4]	Wagner Electric Corporation.	St. Louis, Mo	[3]20,092.00		Oct. 28
				Westinghouse Electric & Manufacturing Co.	Denver, Colo	[5]7,824.00	Shipping point, Sharon, Pa.	Oct. 25
				General Electric Co	Schenectady, N. Y	[6]15,097.00	Shipping points, Philadelphia, Port Richmond.	Oct. 28
				Royal Electric Manufacturing Co.	Chicago, Ill	[7]9,895.00		Oct. 26
				General Electric Co	Schenectady, N. Y	[3]3,573.36	Shipping point, Pittsfield, Mass.	Oct. 28
1128-D	Boulder Canyon, Ariz.-Nev.	Oct. 13	2 flowmeters for measuring the flow of water through turbines at Boulder power plant.	Bailey Meter Co.	Cleveland, Ohio	1,625.00		Oct. 27
1129-D	Shoshone, Heart Mountain, Wyo.	Oct. 16	Preparation and stock piling of concrete aggregates.	Taggart Construction Co	Cody, Wyo	9,900.00		Oct. 24
1132-D	Columbia Basin, Wash.	Nov. 1	Radio-telephone apparatus consisting of 2 transmitters, 2 receivers, 1 gasoline-engine-driven alternator and miscellaneous equipment.	Spokane Radio Co. Inc	Spokane, Wash	1,389.00		Nov. 5
797	Colorado-Big Thompson Co.	Oct. 12	Construction of Green Mountain Dam and power plant.	Warner Construction Co	Chicago, Ill	4,227,206.20		Nov. 12
808	Provo River, Utah	Oct. 27	Construction of Olmsted and Alpine-Draper Tunnels.					[8]
A 38,159-A	Columbia Basin, Wash.	Oct. 10	1-inch o. d. black steel pipe or tubing (2,000,000 feet) 180° bends (4,000) and 90° bends (11,000).	Steel and Tubes, Inc.	Cleveland, Ohio	70,747.36	F. o. b. Odair, Wash	Nov. 14
786	Columbia Basin, Wash.	Oct. 17	Hydraulic turbines and governors for units L-1, L-2, and L-3, Grand Coulee power plant.	Newport News Shipbuilding & Dry Dock Co.	Newport News, Va	[3]1,539,797.52		Nov. 22
				Woodward Governor Co	Rockford, Ill.	[5]70,145.38		Do.
802	Rio Grande, N. Mex.-Tex., Colorado-Big Thompson, Colo.	Oct. 10	Three 11,500 horsepower turbines, governors and 9,000 kilovolt-ampere generators.	Newport News Shipbuilding & Dry Dock Co.	Newport News, Va	[9]226,260.00		Nov. 23
			Two 15,000 horsepower turbines, governors and 12,000 kilovolt-ampere generators.	Woodward Governor Co	Rockford, Ill	[10]59,865.00		Do.
				Allis-Chalmers Manufacturing Co.	Milwaukee, Wis	[11]472,500.00		Do.
1126-D	Boulder Canyon, Ariz.-Nev.	Oct. 5	Boring mill for Boulder power plant.	Hendrie & Bolthoff Manufacturing & Supply Co.	Denver, Colo	46,000.00	F. o. b. Cincinnati, Ohio.	Nov. 22
1131-D	Yakima-Roza, Wash.	Oct. 21	Furnishing and delivering in stock piles 36,000 tons of sand and 59,000 tons of gravel.	Homer G Johnson	Portland, Oreg	65,350.00		Nov. 16

[1] Schedules 1 to 4.
[2] Schedule 5.
[3] Schedule 1.
[4] All bids f. o. b., Kremmling, Colo.
[5] Schedule 2.
[6] Schedule 3.
[7] Schedule 4.
[8] All bids rejected.
[9] Schedules 1 and 2.
[10] Schedules 3 and 4.
[11] Schedules 5 and 6.

Progress of Investigations of Projects

Arizona-California, Colorado River Valleys surveys.—Work was continued on the preparation of the aerial mosaic.

California, Kings River-Pine Flat project.—Studies were continued of Pine Flat, Tehipite, Cedar Grove, and Wishon reservoir sites. Drilling of Tehipite site was completed and work begun at Cedar Grove dam site.

Colorado, Blue River transmountain diversion.—Report of project is nearly completed.

Colorado, eastern slope surveys.—Preparation of reports of the North Republican River, Smoky Hill River, Arickaree River, and Trinidad projects was in progress.

Colorado, western slope surveys.—Studies and surveys were continued of Florida, La Plata, Paonia, Silt and Troublesome projects. Diamond drilling was begun at Harvey Gap dam site on Silt project.

Idaho, Southwest Idaho investigations.—Surveys were continued of tunnel for diversion from South Fork of Boise River to Long Tom Creek in the Mountain Home area.

Idaho, Snake River Storage, South Fork.—Studies and preparation of plans were continued of dams on Elk Creek and at Grand Valley site.

Montana, Gallatin Valley project.—Surveys of the Spanish Creek dam and reservoir site were nearly completed and diamond drilling commenced.

Montana, Marias project.—Surveys of canal lines and of a dam site on Marias River near Shelby were continued. Diamond drilling was completed. About 200,000 acres of land were classified at the close of the month.

Montana, Rock Creek project.—Studies of water supply were made, including effect of Canadian development.

Montana-North Dakota, Fort Peck pumping project.—A reconnaissance of 200,000 acres was completed and surveys were begun of lands found feasible of irrigation by gravity.

Oklahoma, Canton and Fort Supply projects.—Water supply studies were continued of the Fort Supply project and surveys begun of the Canton project.

Oregon, Grande Ronde project.—Preparation of the report was continued, including data on water supply.

Oregon, Medford project.—Water supply

studies were continued and surveys begun of Lake Creek Dam site.

South Dakota, Black Hills investigations.—Surveys of Beaver Creek project were begun, including dam and reservoir sites and canal line.

Utah, Blue Bench and Ouray Valley Projects.—Preparation of reports of both projects was continued.

Utah, Price River-Gooseberry investigations.—Water supply studies and surveys of canal and tunnel lines continued, test pits were dug at Gooseberry Dam site, and topographic survey of Scofield Reservoir was in progress.

Utah, Weber River investigations.—Surveys of Holmes Creek and Adams Reservoir sites and of Hobbs and Holmes Creek Dam sites were completed. Water supply studies were continued.

Utah-Idaho-Wyoming, Bear River surveys.—Surveys of the Nounan Valley Reservoir were completed; surveys were made of dam sites on several streams, and studies completed of a reservoir at Woodruff Narrows, Wyo. Investigation of Saline Springs on Lower Malad River was made.

Colorado River Basin.—Extensive surveys and investigations were continued of the Green River Basin in Colorado, Utah, and Wyoming, including the Dewey Reservoir site near Moab, Utah. A report of the land classification in the Colorado River Basin was in preparation. A boat trip through Split Mountain Canyon, Utah, was made to determine feasibility of several dam sites. A reconnaissance of Little Snake River Basin was made and studies of Three Forks Reservoir site made.

Milk River Beets

THE Chinook (Montana) factory of the Utah-Idaho Sugar Co. continued operation at full capacity without interruptions throughout October. Approximately 15,000 acres of beets had been harvested within the Chinook district of the sugar company, producing approximately 180,000 tons of beets, far exceeding the yield of any previous year. About 11,000 acres were produced on the Milk River project, with an average yield of about 13 tons per acre, which is practically equal to the 1932 record, and it will be necessary to continue the operation of the factory until February 1 in order to handle the entire crop.

Previously an estimate not exceeding 100,000 tons, maximum production, had been made, which amount had not been reached for several years. Increased project development during the last few years has necessitated the enlargement of the factory to handle the annually increasing production. It is now estimated that the maximum which can be handled economically by this factory is around 150,000 tons, and it has been stated that if the production is to be greatly increased, it will be necessary to provide additional refining facilities at some point within the district.

Louis C. Hill, Consulting Engineer, Dies in Pasadena

LOUIS CLARENCE HILL was born at Ann Arbor, Mich., February 22, 1865, and died in Pasadena, Calif., November 6, 1938. Mr. Hill had been in failing health for some time, a stroke being the immediate cause of his death.

Mr. Hill was graduated from the University of Michigan and was professor of hydraulic and electrical engineering in the Colorado School of Mines 1890-1903. He entered the Government service as engineer in the Geological Survey in 1903 and subsequently was employed by the Bureau of Reclamation with which he had a number of important assignments. He supervised the preparation and plans for the Roosevelt Dam on the Salt River project, which at that time was by far the largest dam in the United States.

In 1905 he was placed in charge of all work of the Reclamation Service in Arizona, New Mexico, Texas, Utah, and southern California, with the title of supervising engineer. In 1914 he was appointed United States Commissioner to negotiate with Mexico the division of water of the Colorado River.

The services of Mr. Hill were retained by the water users as consulting engineer, and in that capacity he was also retained by the Government for Boulder Dam, the All-American Canal, now under construction; the Fort Peck Dam, 10 flood control dams in southern Ohio for the War Department; and the Los Angeles flood control project, as well as the Coolidge, Elephant Butte, and Bonneville Dams, and projects of lesser importance.

At the time of his death Mr. Hill was a member of the firm of Quinton, Code and Hill-Leeds and Barnard, with headquarters in Los Angeles.

Mr. Hill was considered one of the ablest engineers in the entire engineering profession. His distinguished service and ability were recognized when in 1937 he was elected president of the American Society of Civil Engineers.

Chief Engineer Walter Eulogizes Louis C. Hill

R. F. WALTER, Chief Engineer of the Bureau of Reclamation, sent the following message to be read at the funeral services for Mr. Hill:

"Louis C. Hill was intimately connected with the activities of the United States Bureau of Reclamation for the past 35 years. His wise counsel and spirit of friendliness in the early days of the Bureau did much toward laying the foundation of loyalty and service upon which the organization was built, and his influence has continued throughout the years. He was an engineer of outstanding ability and was consulted in connection with the designs and construction of nearly all of the major dams built by the Bureau including, among many others, the Roosevelt, Elephant Butte, and Boulder Dams. He was supervising engineer during the construction of Roosevelt Dam and this structure will stand as a lasting monument to him as a builder. Mr. Hill was loved and respected by all who knew him and the Bureau has suffered a loss in his passing."

Carlsbad Community Organization

WPA labor was employed on four projects in and around Carlsbad during October, including sewing, school house, community beach, sidewalk and street extension projects. Work started on October 15 on a $150,000 sewer project in Carlsbad and a $120,000 disposal plant.

Klamath Water Supply

AT the close of October there remained in storage on the Klamath project more than 50,000 acre-feet of water, which is by far the greatest carry-over since the inception of the project. The supply of water for next season is practically assured.

Carlsbad Industry

LARGE shipments of potash were made during October by the two operating potash companies, both plants being in full operation. A full force was employed during that period on the shaft of the Union Potash Co.

Owyhee Public Land Opening

TWENTY-NINE homesteads for which irrigation water will be available next spring are offered by the Bureau of Reclamation on the Succor Creek division of the Owyhee project, near Homedale in Owyhee County, Idaho.

These homesteads will be opened for entry on December 15, 1938, and all applications received prior to that date will have equal standing except that veterans will be given a 90-day preference right of entry.

The available farm units range in size from 17 to 90 acres. At present they are sagebrush lands, but the Bureau of Reclamation has completed canals and laterals and will be prepared to provide water for these farms next season.

In addition to the public land, the Bureau of Reclamation will be prepared in the same area to provide water, with the coming of spring, for 4,675 acres of land, now desert, which is in private ownership. Much of this land also is available for settlement for those who wish to buy it. The sale prices are governed by Government appraisals based on the value of the land as it stands, in its unimproved condition. These appraisals are on file in county offices.

This is the fourth opening of public land on the Owyhee project. On April 16, 1936, 107 units were offered on the Mitchell Butte division of the Owyhee project; on March 17, 1937, 33 units were offered on the Mitchell Butte and Dead Ox Flat divisions; and on January 3, 1938, 50 units were offered on the Succor Creek division.

All farm units included in the previous openings have been filed upon, and they are now, virtually without exception, improved and providing a living for many families.

To be eligible to file on one of the units now being offered, one must have a valid homestead right. Regulations governing homesteading on Federal Reclamation projects require the applicants to appear before an examining board which tests their qualifications. Homesteaders on reclamation projects are required to have at least $2,000 capital, in cash or farm equipment; at least 2 years of farming experience, with credit for additional experience and for experience on irrigated land; and are required to be of good character.

Applicants who are not ex-service men may file their applications but they will not be considered until 90 days after the December 15 dead line, and then they will be considered only for the farm units which have not been taken by qualified veterans. Application blanks may be obtained from the Construction Engineer, Bureau of Reclamation, Boise, Idaho, and must be filed with him.

CONTENTS

THE RECLAMATION ERA • DECEMBER 1938

CUT ALONG THIS LINE

COMMISSIONER,
Bureau of Reclamation,
Washington, D. C.

(Date)..

SIR: I am enclosing my check[1] (or money order) for $1.00 to pay for a year's subscription to THE RECLAMATION ERA.

Very truly yours,

December 1938

(Name)..

(Address)..

....

[1] Do not send stamps.

NOTE.—36 cents postal charges should be added for foreign subscriptions.

Mount Hope Lutheran Church on the Riverton Project

THE second church to be dedicated on the Riverton project during the past year is Mount Hope Lutheran located at the junction of United States Highway 287 and the Pavillion cut-off.

At this point 6 miles south of Pavillion and 18 miles west of Riverton on the direct highway to Yellowstone Park, 1½ acres of land was secured in 1937. Here a frame building 24 by 40 feet was built by Lutheran pioneers on the Riverton project and with the Lutheran church in Riverton serves well the needs of Fremont County. Mount Hope was dedicated on March 13, 1938.

The auditorium which has a seating capacity of 100, faces three western windows against which a beautiful, white altar stands in its place of honor as the center of the church's worship. Sunday school which has an enrollment of 27 is held in the basement. This is also utilized for the meeting place of the various societies of the congregation. There are 17 members in the Young People's Society and between 65 and 70 is the average attendance at church which shows the sincere appreciation of these settlers for a place to worship. The efforts of these people linked with the ready service of the Rev. E. Rummel of Riverton have made this well equipped, adequate building possible.—*Goldie L. Bezold.*

Exterior and interior views of church

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W. I. Swanton, Engineering Division

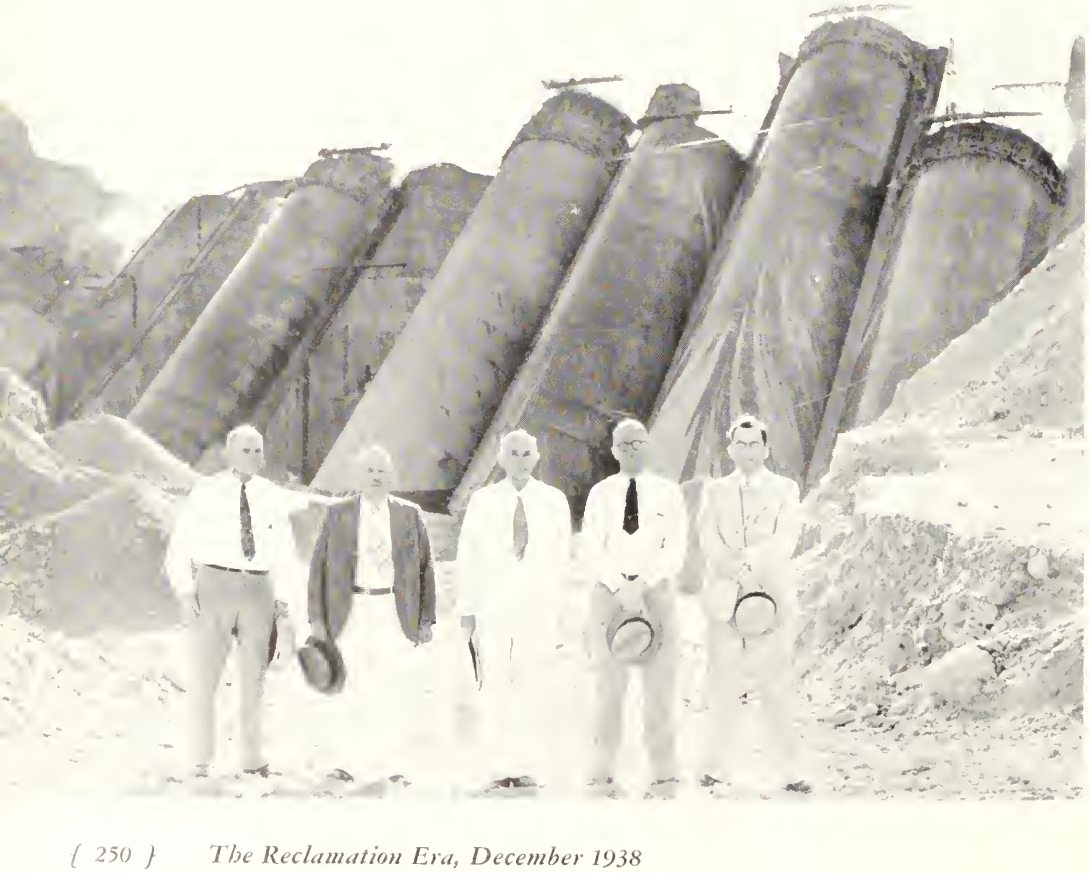
Senator Hayden Visits Bartlett Dam Salt River Project, Arizona

WITH a keen interest in irrigation development in Arizona, especially in storage control on the Verde River, Senator Carl Hayden made a recent trip to Bartlett Dam and with considerable satisfaction viewed the structure, then 80 percent completed, with a fair chance of storing some water during the coming flood season. On the senator's first trip to the dam the road ended several miles away and he hiked over the mountains to observe the diamond drill and other exploratory work then in progress.

Years ago when a boy, Senator Hayden fished along the Verde and at that time he, no doubt, had fond dreams of the future harnessing of this turbulent river, making it a useful stream.

In the accompanying photograph are shown, left to right, H. J. Lawson, Chief Engineer; Lin B. Orme, president, Salt River Valley Water Users' Association; Senator Carl Hayden; E. C. Koppen, construction engineer, Salt River project; and Paul Rocca, secretary to Senator Hayden.

Left to right: H. J. Lawson, Chief Engineer; Lin B. Orme, President, Salt River Valley Water Users Association; Senator Carl Hayden; E. C. Koppen, Construction Engineer; Paul Rocca, Secretary to Senator Hayden



Labor on Minidoka Project

THE crop harvest and operation of the two sugar factories on the Minidoka project utilized all available labor during the season.

BUREAU OF RECLAMATION SETTLEMENT AND ECONOMIC DATA, 1938

State	Project	Irrigated farms		Towns		Number of schools	Number of churches	Banks			
		Number	Population	Number	Population			Number	Capital stock	Deposits	Number of depositors
Arizona	Salt River	9,000	67,600	12	95,400	91	152	7	$2,618,900	$57,586,000	25,000
Arizona-California	Yuma	1,666	3,375	5	8,700	13	27	1	250,000	1,575,635	2,230
California	Orland	673	1,964	1	1,200	9	10	1	(1)	(1) 1,053,881	3,232
Colorado	Grand Valley	521	1,496	6	18,950	17	38	3	275,000	4,469,072	7,600
	Uncompahgre	1,617	5,922	3	8,350	28	35	4	325,000	3,818,892	8,462
Idaho	Boise	4,020	15,705	16	50,500	58	88	1	1,210,000	(2)	(2)
	Minidoka	3,129	11,066	6	7,825	22	52	6	(1)	(1)	(1)
Montana	Bitter Root	325	1,111	6	4,500	18	13	4	188,806	1,658,365	4,150
	Frenchtown	34	120	3	17,150	15	23	2	400,000	8,764,093	11,110
	Huntley	631	2,160	5	774	8	6	1	25,000	158,759	300
	Milk River	650	2,427	17	11,532	32	36	7	400,000	4,572,417	7,122
	Sun River	775	1,841	6	821	10	11	1	25,000	344,791	300
Montana-North Dakota	Lower Yellowstone	605	2,760	7	4,055	18	22	2	89,128	1,090,545	2,800
Nebraska-Wyoming	North Platte	2,820	9,276	17	22,352	70	54	9	454,500	7,074,961	14,270
Nevada	Humboldt	56	150	1	1,200	4	4	1	60,000	834,450	1,430
	Newlands	741	2,985	4	2,200	16	12	1	(2)	820,000	1,175
	Truckee River Storage	300	1,650	2	28,000	24	15	3	609,000	16,103,000	15,700
New Mexico	Carlsbad	461	2,010	4	8,000	9	12	2	100,000	1,701,188	2,900
New Mexico-Texas	Rio Grande	5,423	26,514	36	133,012	88	128	6	775,000	33,543,879	31,255
Oregon	Umatilla	430	1,421	5	1,585	7	10	1	25,000	365,000	900
	Vale	410	1,600	3	1,600	5	12	1	25,000	369,700	1,310
Oregon-California	Klamath	906	2,767	5	17,590	30	35	5	(1)	(1)	(1)
Oregon-Idaho	Owyhee	1,435	5,607	5	7,000	26	23	2	(1)	(1)	(1)
South Dakota	Belle Fourche	900	2,372	5	3,550	28	17	2	425,000	2,500,000	5,200
Utah	Hyrum	375	1,500	3	3,500	5	6	(3)	(3)	(3)	(3)
	Moon Lake	600	2,550	10	4,400	17	15	1	49,500	300,000	1,550
	Ogden River	1,230	1,900	4	53,960	25	56	4	1,030,060	12,000,000	27,783
	Sampete	210	1,160	2	1,950	5	4	(2)	(2)	980,000	(2)
	Strawberry Valley	2,200	5,550	12	25,000	27	26	4	185,000	1,163,300	8,900
	Weber River	2,100	10,000	10	48,000	46	50	9	1,175,000	20,090,000	9,500
Washington	Okanogan	401	961	3	4,700	9	8	2	75,000	1,067,052	2,400
	Yakima	5,543	18,040	23	50,268	78	62	9	1,425,000	6,360,574	13,602
Wyoming	Riverton	368	1,320	2	150	2	4	(3)	(3)	(3)	(3)
	Shoshone	979	2,801	5	3,052	3	10	1	51,500	544,762	1,200
	Total 1938	51,834	222,681	254	650,826	863	1,076	106	12,532,334	190,820,316	211,381

[1] Branch banks. Information not available. [2] Data is not available. [3] No banks on project or in project towns.

Errata

CORRECTIONS are in order to the following statements occurring in the October issue of the RECLAMATION ERA:

On page 204, in the article California's Golden Girl an obvious typographical error was made in the parenthetical sentence in the first paragraph, which should read "It was not until January 1848, however, that Marshall made his discovery of gold on Sutter Creek." The year was given as 1838.

On page 207, in the article Visitors at Coulee Dam, Mississippi was credited in the first column with 58 and in the second with 5 visitors. In the first column the 58 visitors should have been credited to Massachusetts rather than to Mississippi.

Orland Storage

AT the end of this season the storage reservoirs of the Orland project will contain the greatest carry-over of any year since the inception of the project and an adequate water supply for next season is practically assured.

New College To Be Erected on the Grand Valley Project

BY vote on September 30 of 8 to 1, Mesa County, Colo., in which the Grand Valley project is located, approved the construction of the new Mesa College to cost $300,000.

Yakima Grapes

THE Yakima Valley Grape Growers Association estimates that $32,500 has been received this fall by about 150 members for 1,300 tons of grapes. The average price for the Concord variety was $25 a ton, while early grapes brought $30 a ton. The association, which was organized in 1924, is said to be the only grape cooperative marketing organization in the country.

Washington Irrigation Institute Meets

THE twenty-sixth annual meeting of the Washington Irrigation Institute was held in Ellensburg, Wash., November 17–18. The program this year will stress farm management, successful methods employed by farmers, the marketing of crops, and specialization.

Minidoka Harvest

WITH the beet and potato harvest on the Minidoka project well toward completion at the close of October, yields were exceptionally large, and the report showed that the Amalgamated Sugar Co. had received 128,000 tons of beets for grinding at the Burley and Paul factories. One farmer reported a yield of 33 tons of beets per acre on a small tract of land.

Willwood Farms

WITH the highest ratings, seven applicants for the seven public land farm units recently opened to entry on the Willwood division of the Shoshone project have been selected by the board of examiners.

Orland Displays Win Prizes at Glenn County Fair

THE annual Glenn County Fair, which was held in Orland, September 8–October 1, was a complete success in every way. Not only were the displays of farm products and livestock exceptionally good, but the community display booths would have attracted favorable attention at any State fair. The use of the project and its storage works as a theme was very noticeable in the displays, and first prize in the women's class was awarded to the Orland Women's Improvement Club for a relief map featuring the town of Orland and the project. The second prize was won by the Lutheran Ladies' Aid with a replica of Stony Gorge Dam.

New Post Office

THE city of Sidney, Mont. (Lower Yellowstone project), has been awarded a Federal post office, and it is expected that construction of this building will commence in the near future.

Filling of Lake Mead

By IRVING C. HARRIS, *Director of Power, Boulder City, Nev.*

DURING the year 1934, diversion tunnels Nos. 2 and 3, the two tunnels nearest to the river, were plugged with concrete just above their intersections with the inclined tunnels from the intake towers. Tunnel No. 1, the outer tunnel on the Nevada side, was also plugged just above the intersection with the inclined tunnel from the Nevada spillway. Temporary gates were installed in this tunnel plug for regulation of the river flow below the dam until storage of water in the reservoir was sufficient for regulation through the intake towers and the outlet system.

The intake towers are located two on each side of the canyon in recesses cut in the rock, the bases of which are at elevation 895.0, or 255 feet above the bed of the river, at about elevation 640±. There are gates in the towers at two elevations, the lower set at elevation 895 and the upper ones at 1,045. Placing the tower foundations approximately 255 feet above the old river bed produces 3,325,000 acre-feet of storage of water that is not available for use for irrigation or power, but silt deposited within this zone will not reduce usable water storage capacity, and this arrangement will prevent anything but clear water being passed through the penstocks, valve outlets, and turbines.

Temporary Gates Regulate River's Flow

By the end of January 1935, work preparatory to storage of water in Lake Mead was completed, and, on the morning of February 1, 1935, the huge bulkhead gate at the upstream portal of diversion tunnel No. 4, then carrying the flow of the Colorado River, was lowered, thus making it possible to regulate the flow of the river by means of the temporary gates in the tunnel no. 1 plug and to start storage of water in the reservoir.

During the year 1935, the inflow into Lake Mead was 10,688,787 acre-feet, or about 60 percent of the normal flow of the Colorado River. Of this amount, 6,324,297 acre-feet were by-passed to supply water for irrigation and other purposes. The maximum storage for the year was 4,578,000 acre-feet with the water surface elevation at 928.45, which occurred on July 31, 1935. Boulder Dam, then in its first year of operation, not only supplied sufficient water to those along the river below the dam, but also protected them from a flood of 105,000 cubic feet per second, the highest since commencement of construction.

The outflow was regulated by the use of the intake towers and outlet system for the first time on February 10, 1936, when the upper Arizona penstock system was filled through its connecting tower, the upstream Arizona intake tower, and the discharge regulated through the 84-inch needle valves in the Arizona canyon wall valve house. It was not until May 1, 1936, that there was sufficient storage in the reservoir to warrant the final closing of the temporary gates in the plug in tunnel no. 1.

The inflow for 1936 was 12,397,272 acre-feet, nearly 2,000,000 acre-feet greater than in 1935 and for 1937, the inflow was 12,417,608 acre-feet, very nearly identical with 1936. Requirements downstream necessitated the discharge of 5,634,425 acre-feet in 1936, and 6,020,305 in 1937. To October 1 of this year the inflow was 14,401,869 acre-feet, or greater than any previous year of storage.

The maximum storage for the year of 1936 of 9,640,000 acre-feet occurred on September 10, at which time the water surface elevation was 1,025.87. In 1937, storage increased to a maximum for the year of 15,701,000 acre-feet on July 28, and this year the maximum to date of 23,161,000 acre-feet occurred on September 26.

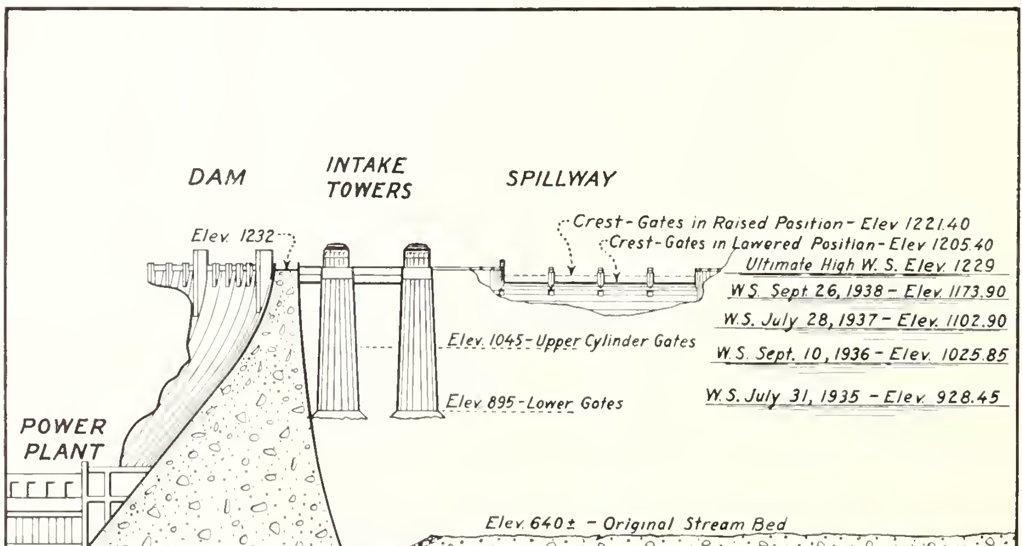
The greatest portion of storage each year occurs during the spring floods, with the river returning to normal about the first of August. Occasionally, as was the case this year, flash floods on the river are stored during the fall and winter months.

At its peak this year, on September 26, the water surface elevation was 1,173.70, creating a reservoir with a maximum depth of about 533 feet, the deepest and largest artificial body of water in the world. Its length was 115 miles with a maximum width of nearly 8 miles, covering 119,950 acres.

Of the 30,500,000 acre-feet capacity of the reservoir, the upper 9,500,000 acre-feet of storage has been allocated to flood control. It is planned that this storage space will be available at the beginning of each year's flood season. Normally Lake Mead will be operated between the elevations of 1,140 and 1,200, occasionally rising to an elevation as high as 1,210 and falling as low as 1,000 in case of a succession of dry years.

The two spillways, one on each side of the canyon, will carry an overflow up to 400,000 cubic feet per second. The spillway weir with the drum gates in the lowered position is at elevation 1,205.40, or about 32 feet above this year's peak surface elevation. These drum gates in the raised position will create 16 feet of additional storage, or an additional volume of 2,217,000 acre-feet.

In case the run-off from the watershed should be about normal or above normal this coming season, it will be possible to allow the water level to rise high enough to enable the spillways to be operated and tested if it is considered advisable. The first discharging of the spillways of the world's greatest reservoir will doubtless be a very notable occasion.



Reclamation Reports to Harry Slattery

Under Secretary of the Interior

(1) Under Departmental Order no. 1312 the following supervisory assignments over bureaus and other Interior Department agencies have been made by Secretary of the Interior Ickes:

Under Secretary of the Interior:

1. General Land Office.
2. Bureau of Reclamation.
3. Geological Survey.
4. Bureau of Mines.
5. Division of Grazing.
6. Petroleum Conservation Division.
7. United States Board of Geographic Names.

First Assistant Secretary of the Interior:

1. Departmental Administration.
2. Office of Chief Clerk of the Department.
3. Office of Director of Personnel.
4. Office of Supervisor of Classification.
5. The Budget.
6. (Public Works Administration, as assigned by the Administrator.)
7. (Puerto Rico Reconstruction Administration, as assigned by the Administrator.)

Assistant Secretary of the Interior:

1. Bureau of Indian Affairs.
2. National Park Service.
3. Office of Education.
4. Eleemosynary Institutions:
   - St. Elizabeths Hospital.
   - Freedmen's Hospital.
   - Howard University.
   - Columbia Institution for the Deaf.
5. Division of Territories and Island Possessions:
   - Alaska.
   - Alaska Railroad.
   - Alaska Road Commission.
   - Hawaii.
   - Virgin Islands.
   - Puerto Rico.
   - The Virgin Islands Company.

Solicitor for the Department:

(2) In the absence of the Secretary, the Under Secretary will act as Secretary of the Interior. In the absence of the Secretary and the Under Secretary, the senior Assistant Secretary on duty will act as Secretary.

(3) In the absence of the Secretary, the First Assistant Secretary will sign personnel orders.

(4) The First Assistant Secretary, under the supervision of the Secretary, will be the administrative officer of the Department.

(5) The Division of Investigations and the Office of Information, which office shall supervise the Division of Motion Pictures, will be

(*Continued on page 256*)

POWER PLANTS OPERATED ON BUREAU OF RECLAMATION PROJECTS DURING FISCAL YEAR 1937–38

Project	Name of plant	Outgoing line voltage	Plant capacity (kilowatt-amperes)	Number of units	Head in feet	First cost of plant (all features)	Cost of operation and maintenance without depreciation (all features)	Estimated depreciation	Cost per kilowatt-hour, exclusive of depreciation	Distribution of kilowatt-hours generated: Sold to consumers (kilowatt-hours)	Irrigation and drainage requirements (kilowatt-hours)	Used for other purposes (kilowatt-hours)	Losses (kilowatt-hours)	Total output (kilowatt-hours)	Gross power sales
Boise	Black Canyon	66,000	10,000	2	75.4 to 96.7	$114,317.21	$11,138.98	None	0.00022	[1] 26,491,262	23,067,662	1,435,700	1,164,687	[2] 50,942,359	(3)
	Boise River	22,000	1,875	3	24.9	167,905.37	5,439.98	None	.0023	(4)	(4)	(4)	(4)	(4)	
Boulder Canyon	Boulder	33,000 69,000 138,000 287,500	[5] 458,500	[5] 8	522	26,563,314.61	(6)	(6)	(6)	1,427,928,442		13,929,455	10,427,103	1,452,285,000	$1,888,132.84
Grand Valley	Grand Valley	2,300	3,750	2	73 to 79	210,500.00	(7)	(8)	(7)	(7)	(7)	(7)	(7)	7,226,920	(7)
Minidoka	Minidoka	33,000	10,000	6	47.65 average 49.63 maximum	1,110,195.86	137,192.14	$38,002.00	.002	21,812,125	34,539,966	7,904,661	3,857,654	[9] 68,114,406	200,433.16
	American Falls [10]	33,000	540	1	44	[11] 76,975.00									
Newlands	Lahontan	2,300 33,000 66,000	1,875	3	110 to 20	324,793.52	19,766.38	7,619.84	.00016	3,067,458	101,302	64,430	359,080	3,592,270	35,735.80
North Platte	Guernsey	33,000	6,000	2	70 to 90	454,244.27	14,578.38	None	.000871	23,618,759	15,489	320,347	1,869,184	[12] 25,823,770	271,368.97
	Lingle	33,000	1,750	4	106	184,791.74	12,938.93	None	.001421	(13)	(13)	(13)	(13)	(13)	(13)
Rio Grande	Elephant Butte	2,300	150	1	18 to 180	8,410.50	2,175.94	None	.0054	None	None	400,610	(14)	400,610	None
Riverton	Pilot Butte	33,000 2,300	2,000	2	100 average	262,809.00	12,611.72		.006742	1,218,765	None	549,634	102,150	1,870,549	26,196.21
Salt River [15]	Roosevelt	110,000	19,250	7	70 to 240	1,372,193.73	[16] 1,241.21	68,609.69	.001388					87,351,000	
	Arizona Falls	110,000	1,060	2	19	115,566.47	8,464.46	5,778.32	.002249					3,761,200	
	Chandler	11,000	600	1	40	177,410.37	8,680.11	8,870.52	.002123					4,088,180	
	Cross Cut	11,000 40,000	5,250	6	111	663,926.33	25,766.26	33,196.02	.001688					15,267,000	
	Horse Mesa	110,000	33,300	3	265	982,756.47	63,798.87	49,137.82	.000542					117,780,000	
	Mormon Flats	110,000	8,750	1	40 to 150	472,011.68	15,367.53	23,600.58	.000661					23,146,000	
	Stewart Mountain	45,000	13,000	1	35 to 114	344,070.32	13,039.57	17,203.52	.000332					39,310,000	
	South Consolidated	40,000	2,000	2	34	176,202.81	8,918.56	8,810.14	.000785					11,365,600	
	Total									[17] 397,886,897	[17] 34,106,259	[17] 393,184	[17] 64,027,276	[17] 496,413,616	[15] 3,748,256.94
Shoshone	Shoshone	33,000	7,000	3	220	883,037.48	[18] 24,374.33	None	.00214	10,051,779	None	27,955	1,281,866	11,361,600	106,092.65
Strawberry Valley	Strawberry Valley	11,000	1,312	3	126.5 to 48.5	[11] 175,900.00	[19] 11,300.00	None	.002157	[20] 5,571,636	None	59,789	154,461	[21] 5,238,286	57,688.13
Yakima:															
Kennewick	Prosser	66,000	3,000	1	10	404,843.88	8,262.28	None	.00034	[22] 24,076,296		43,184	381,240	21,500,570	
Sunnyside	Rocky Ford	6,600	187	1	73	23,000.00	1,516.71	1,056.40	.0023		670,900			670,800	
Yuma	Siphon Drop	33,000	2,000	2	14.29 maximum 9.82 average	317,396.00	25,012.32	7,950.00	.003727	5,423,184	1,206,404	82,991	420,007	[23] 7,131,889	44,056.63

[1] To Idaho Power Co., T. E. Connolly, Inc., Lackey gravel plant, and C. C. C. Camp BR-26.
[2] Includes Boise River power plant. 1,216,952 kilowatt-hours purchased from the Idaho Power Co.
[3] Not reported.
[4] Included with Black Canyon power plant.
[5] 5 units at 82,500 kilovolt-amperes; 1 unit at 40,000 kilovolt-amperes; and 2 units at 3,000 kilovolt-amperes installed and operating as of June 30, 1938.
[6] Not available.
[7] Operated by contractor.
[8] None—constructed with advanced funds.
[9] Includes 14,169,406 kilowatt-hours from Idaho Power Co.
[10] Has not been operated since 1927.
[11] Estimated.
[12] Total of both plants: Guernsey, 9,085,070 kilowatt-hours; Lingle, 16,738,700 kilowatt-hours.
[13] Included with Guernsey power-plant data.
[14] Unknown.
[15] Reports are for calendar year of 1937.
[16] Total for system. Includes 194,341,636 kilowatt-hours of purchased power.
[17] Total for system.
[18] Includes cost of Garland substation, amounting to $8,292.72.
[19] Costs for the month of June 1938 are estimated; books for that month were not closed at the time of preparing this statement.
[20] Includes 2,627,300 kilowatt-hours of dump energy.
[21] Exclusive of 550,600 kilowatt-hours purchased.
[22] Includes 4,800,000 kilowatt-hours of winter power delivered to Pacific Power & Light Co. in payment for transmission of power to irrigation districts.
[23] Includes 673,600 kilowatt-hours purchased.

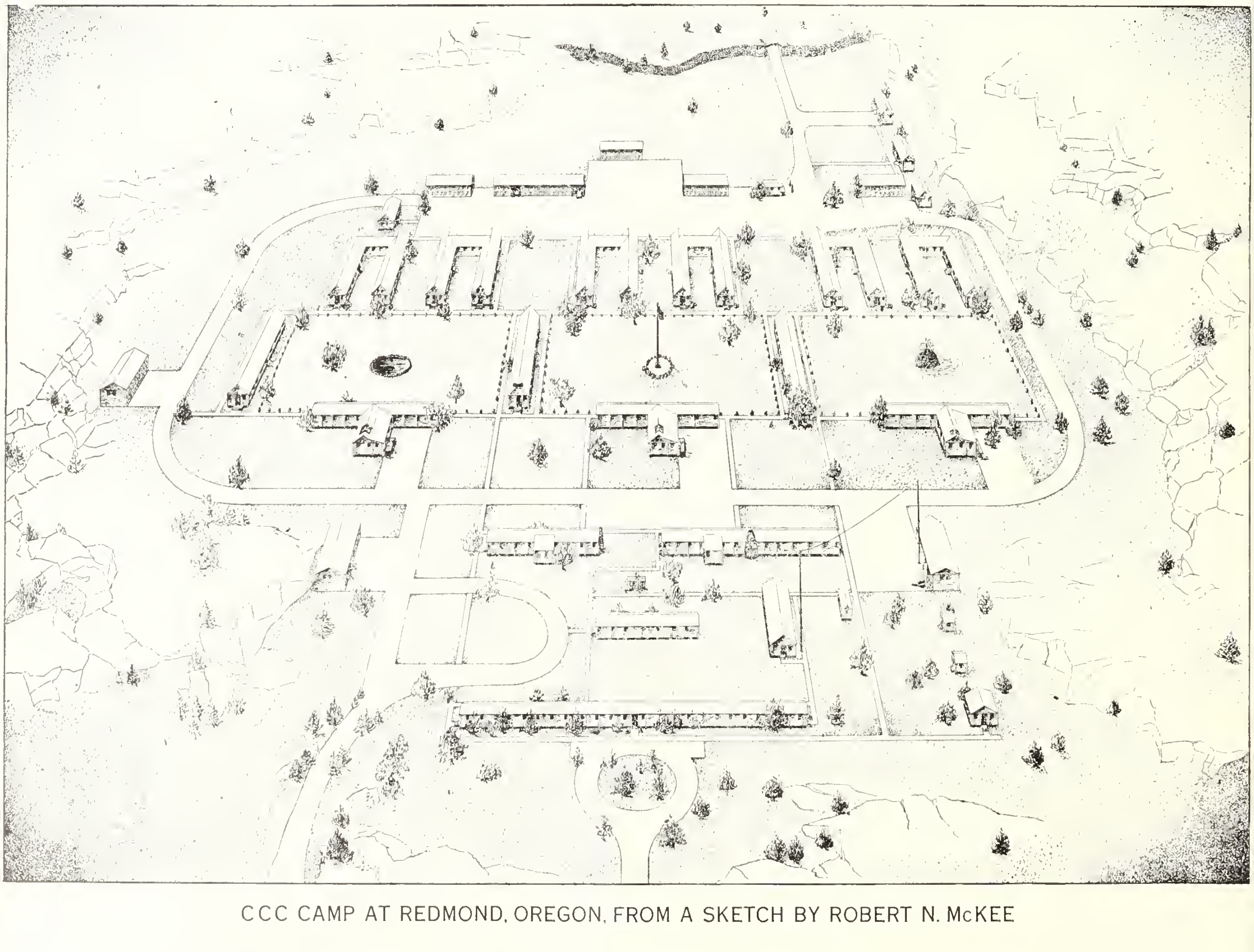
Deschutes Project Canal Work Started With CCC Camp Dedication

REPRESENTATIVE Walter M. Pierce and Construction Engineer C. C. Fisher each grasped a handle of the electric plunger which fired the first blast on the afternoon of October 21, for excavation of the North Unit Canal of the Deschutes project, Oregon. This dynamite blast marked the dedication of the three-company CCC Camp Redmond held in connection with the twenty-eighth annual meeting of the Oregon Reclamation Congress, in convention at Redmond, Oreg.

Five thousand people, including large delegations from Bend, Madras, and Prineville, witnessed the ground-breaking ceremonies for the 65-mile long North Unit Canal, an integral part of the planned development of the Deschutes project. In addition to Representative Pierce and Mr. Fisher, other speakers at the ceremonies included Percy A. Cupper, former State engineer representing the Jefferson Water Conservancy District, Rufus C. Holman, State treasurer and member of the State Reclamation Commission, Mayor F. S. Simpson of Bend, Mayor E. C. Parker of Redmond, Capts. B. O. Garrett, Clarence Hebert, and B. A. Johnson representing the United States Army, Glen B. Wood, senior educational adviser for the camp, and Bill Ashworth. Following the ceremonies a huge "Kentucky barbecue" was served by the CCC boys at the new camp.

Constructed by the Army, Camp Redmond, the only three-company unit now on the Pacific coast, is the winter home of the CCC companies assigned to assist in the construction of the Deschutes Federal Reclamation project. It is expected during this winter, the principal activities of the CCC enrollees will be on the first stages of the construction of the North Unit Canal.

Camp Redmond, built on the outskirts of Redmond, Oreg., covers an area of 40 acres with its 43 buildings attractively placed as shown in the accompanying pen-and-ink sketch. Over 100,000 square feet—2½ acres of floor space—must be kept clean in the three complete sets of barracks, mess halls, and offices. Educational facilities for the 600 enrollees living in the camp are provided by a large educational building 250 feet in length, which is equipped with a shop. An airplane engine and Diesel engine separately housed, are available for the educational program. A camp store, officers' quarters, technical personnel quarters, a barber shop, and laundry complete the camp. Radio station WUON has been established by the Army to provide direct communication between the camp and the district headquarters at Vancouver Barracks, Wash.



CCC CAMP AT REDMOND, OREGON, FROM A SKETCH BY ROBERT N. McKEE

Green Mountain Dam, Colorado-Big Thompson Project, Colorado

Highest and Largest of Reclamation Earth-Fill Dams

THE Green Mountain Dam, bids for which were opened at Denver, Colo., on October 12 under Specifications No. 797, will be the highest and largest earth-fill dam ever built by this Bureau. The height will be about 270 feet above the bed of the river and the volume about 4,500,000 cubic yards of material. It will be the highest earth-fill dam for continuous reservoir operation in the world. Green Mountain Dam will top the 266-foot Alcova Dam on the Kendrick project in Wyoming, and will be larger than the Vallecito Dam on the Pine River project in Colorado, with its 3,440,000 cubic yards.

The dam site is located on the Blue River, a tributary of the Colorado, about 16 miles south of Kremmling, in Summit County, Colo., and will form a reservoir with an area of more than 2,000 acres and capacity of 152,000 acre-feet. Of this capacity 52,000 acre-feet will be utilized as replacement in western Colorado, of the water which would be usable there if not withheld or diverted by the Colorado-Big Thompson project; 100,000 acre-feet will be stored primarily for power purposes. The purpose of the Colorado-Big Thompson project is to furnish a supplemental water supply for several hundred thousand acres of land in the Northern Colorado Water Conservancy District on the eastern slope of the Continental Divide, in the vicinity of Greeley, Colo., and along the South Platte River basin as far as Julesburg, Colo.

The dam embankment will contain about 3,500,000 cubic yards of an impervious material consisting of clay, sand, and gravel, rolled in 6-inch layers. At the base the width of the embankment will be more than 1,500 feet and the crest width will be 40 feet. The downstream face will be composed of porous material consisting of 740,000 cubic yards of cobbles and coarse slide rock with slopes of 2½ to 1 and 5 to 1 at the toe. The upstream water face will have a slope of 3 to 1 and be paved with rock riprap 3 feet in thickness. Concrete cut-off walls with footings extending into bedrock, will be constructed near the axis and upstream from the axis of the dam, and the main concrete cut-off wall will extend the full length of the rock surface of the abutments of the dam, and into the dam foundation.

Outlet works.—The outlet works will consist of a trashrack structure at the inlet; a 13-foot 6-inch diameter circular concrete-lined inlet shaft; an 18-foot diameter circular concrete-lined tunnel approximately 810 feet long, extending from the diversion inlet to a gate chamber; a gate chamber in which will be installed two 102-inch diameter ring-seal gates; a hoist shaft and hoist house constructed over the gate chamber; a concrete lined, wide-horseshoe-shaped tunnel 15 feet 9 inches high, 23 feet 3 inches wide, and approximately 710 feet long, extending from the gate chamber to the outlet portal, in which will be installed two 102-inch diameter welded plate-steel penstocks.

Spillway.—The spillway is located at the left abutment of the dam and will be a concrete-lined open channel approximately 1,070 feet long. The discharge through the spillway will be controlled by three radial gates, each 25 feet long and 22 feet high, installed at the crest of the spillway.

Power plant.—The Green Mountain power plant will be located on the right bank of the river downstream from the dam. The powerhouse will be of reinforced concrete 67 feet wide by 97 feet long and will house two main generating units. Each generating unit will consist of a 12,000-kv-a, vertical-shaft generator with direct-connected exciters, driven by a 14,100-horsepower turbine.

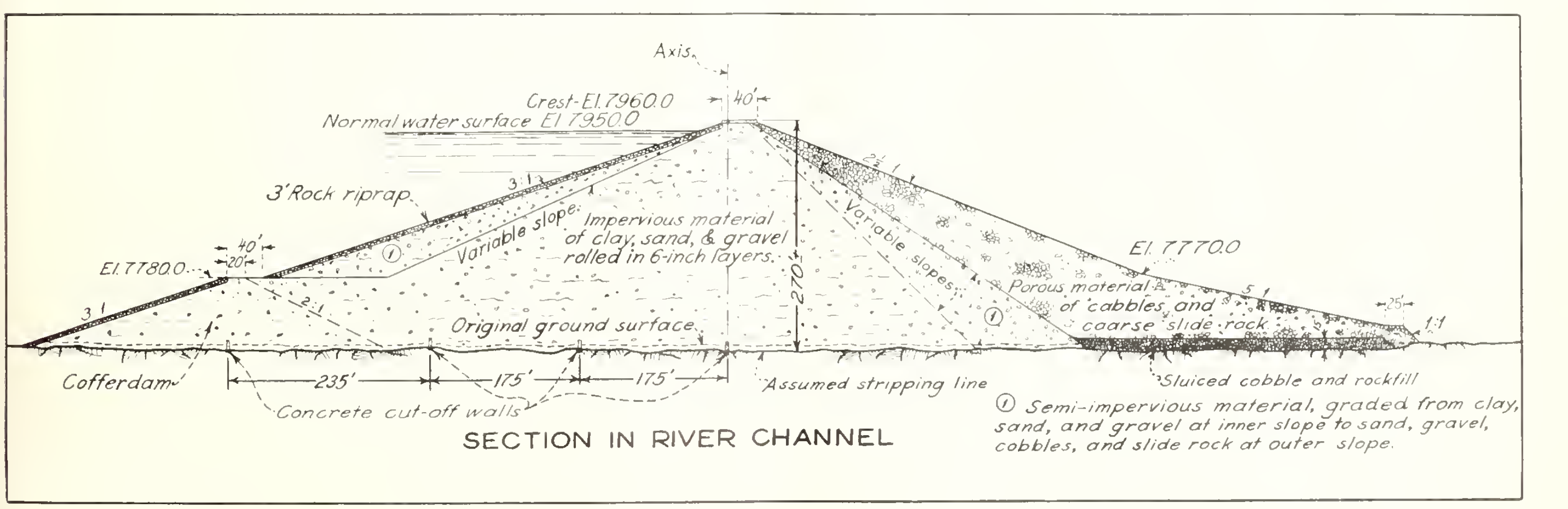
The low bid of $4,227,206.20 was submitted by the Warner Construction Co. of Chicago, Ill. The contractor will have 1,620 calendar days to complete the contract for construction of the dam and power plant.

Colorado-Big Thompson Contract Awarded

THE first contract for construction work on the Colorado-Big Thompson project, Colorado, was awarded on November 16 by Secretary of the Interior Harold L. Ickes to the Warner Construction Co. of Chicago, Ill., on its bid of $4,226,206.20. This contract covers both the building of the Green Mountain Dam and the Green Mountain power plant, located on the Blue River about 16 miles southeast of Kremmling, Colo.

A contract with the Northern Colorado Water Conservancy District for repayment of the costs of the project which have been allocated to irrigation provides that the district must repay one-half of the estimated $44,000,000 cost of the project, except that its maximum obligation is limited to $25,000,000. The Federal Government assumes the other half of the costs, which are chargeable to power and will be repaid from power revenues.

Approximately 175,000 people living on 615,300 acres in northern Colorado, who derive their livelihood either directly or indirectly from farming, will be benefited by the project. Their lands are now under cultivation and are highly improved but, due to lack of adequate and dependable supplies of water, they are subject annually to excessive crop losses which can be avoided only by importation of water.



SECTION IN RIVER CHANNEL

Reclamation Organization Activities

Commissioner Page

BY invitation John C. Page, Commissioner of Reclamation, attended and addressed the annual convention of the Association of Land-Grant Colleges and Universities in session at Chicago, November 16, and on the following day he attended a conference of Western States land-grant college presidents, experiment station and extension directors. His address appears in this issue.

From Chicago, Mr. Page went to Denver to confer with Chief Engineer Walter on reclamation matters and returned to Washington on November 21.

Field Men in Washington

R. F. WALTER, chief engineer; J. L. Savage, chief designing engineer; John J. Hammond, senior engineer; L. N. McClellan, chief electrical engineer; E. B. Debler, hydraulic engineer; and Spencer L. Baird, district counsel, all of Denver, Colo.; F. A. Banks, construction engineer, Coulee Dam, Wash.; H. W. Bashore, construction engineer, Kendrick project, Casper, Wyo.; J. S. Moore, superintendent of the Yakima project, Yakima, Wash.; H. J. S. Devries, district counsel, El Paso, Tex.; and W. T. Trimble, chief ranger, Boulder City, Nev., were called to Washington during December for consultation on Bureau matters.

PERSONNEL CHANGES

THE following recent personnel changes in the Bureau of Reclamation have been authorized by the Secretary of the Interior:

Appointments

Denver Office:

Assistant engineers: Thos. A. McLennan, Edmund W. Riley, Leland S. Schuch (vice Ned L. Lucas), and Ernest L. Harvey.

Junior engineers: Ray I. Brasaemle, Abe Olshansky, Kenneth G. Tower, Alfred T. Lewis, Albert T. Knuckey, Marsh F. Beall, John L. Bauer, Samuel Fingerman, Jr., Howard D. Larson, Herbert C. Cox, Garry H. Austin, George W. Bates, Carlos G. Bates, Jr., Bernard D. Murphy, Haywood G. Dewey, Jr., John H. Ludwig, Ernest R. Dexter, Kenneth C. Taylor, Lee W. Crandall, William H. Wolf, William Rhett, Alex F. Strand, Joseph Robert Harkness, Arthur R. Linden, David H. Jarvis, Donald D. McGregor, Joseph Henry Maynard, Terence P. A. Polley, and James Wright.

Colorado River Investigations, Lyman, Wyo.:

Assistant engineer, Henry G. Berghorn.

Central Valley, Kennett Division:

Junior aquatic biologist, Leo F. Erkkila, vice Francis H. Sumner.

Colorado River, Austin, Tex.:

Assistant engineer, Boyd Austin.

Columbia Basin:

Junior engineers: Charles A. Dike, Norman G. Holmdahl, Jack I. Neff, Carl A. Cramer, George F. Hartman, Walter E. Rogers, Barden Wilbar, Harry H. Chenoweth, Raymond K. Seely, Glenn H. Trowbridge, Forrest C. Morgan, Benson Chandler, and William A. Gillam.

Colorado River Basin investigations, Salt Lake City, Utah:

Associate engineer, Roscoe E. Van Liew.

Colorado River Basin investigations, Paonia, Colo.:

Junior engineer, James C. Douglass.

Transfers

To Denver:

Engineer, Herman F. Bahmeier, from Upper Snake River project.

Associate engineer, Francis J. Thomas, from Caballo Dam, N. Mex.

To Ogden River:

Engineer, Norman T. Olson, from Kendrick project, Rawlins, Wyo.

To Kings River Pine Flat irrigation and flood control secondary project, Fresno, Calif.:

Assistant engineer, Leopold I. Mastrofini, from Parker Dam project, Parker Dam, Calif.

To Rio Grande:

Assistant engineer, Wm. Lee Davis, Jr., from junior engineer, Denver.

Associate engineer, Cecil O. Dale, from assistant engineer, Parker Dam project.

To Tucumcari:

Engineer, Harold W. Mutch, from associate engineer, Denver.

To Central Valley, Kennett Division:

Engineer, Rufus C. Thaxton, from Sacramento, Calif.

Assistant engineer, Elmer L. Chapman, from Denver.

To Deschutes:

Associate engineer, Wm. F. Bingham, from Denver.

Separations

Denver Office:

Junior engineers: John Baird and Eugene W. McGlone.

Columbia Basin:

Junior geologist, Wm. H. Irwin.

Rio Grande, Caballo Dam:

Assistant civil engineer, J. Lester Brown.

The services of all of these employees were terminated without prejudice.

Reclamation Reports to Harry Slattery

(Continued from page 253)

under the direct supervision of the Secretary of the Interior.

(6) The Chief Clerk will have immediate supervision over the Purchasing Office, the Miscellaneous Service Division, the Division of Mail and Files, the Office of Exhibits, the garage, the dispensary, and the telephone service. He will sign specially designated papers and documents in the absence of the Assistant Secretary.

J. S. Moore, Yakima Superintendent Elected President of Washington Irrigation Institute

AT the twenty-sixth annual meeting of the Washington Irrigation Institute, which closed its sessions in Yakima on November 18, J. S. Moore, superintendent of the Yakima project, was elected president of the organization. Mr. Moore was in attendance but left during the banquet on November 17 for Washington, D. C., to attend a conference of Bureau officials.

The greater part of the morning of the eighteenth was devoted to a discussion of the menace of weeds in irrigation farming. V. W. Russell, manager of the Kittitas Irrigation District, and chairman of the State weed legislation committee, acted as chairman of this discussion. An illustrated lecture on Coulee Dam given by S. E. Hutton, Assistant Director of Publicity for the Bureau, featured the banquet given at the Senior High School.

Community Developments on Minidoka Project

AT Rupert, Idaho (Minidoka project), needed developments of the city water supply are planned to cost $5,000, of which $2,454 has been obtained as a grant from the Public Works Administration.

At Burley the sum of $39,841 of Works Progress Administration funds has been allotted for improvement of the municipal airport, which includes a hangar 80 by 100 feet, construction of runways, et cetera.

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ADMINISTRATIVE ORGANIZATION OF THE BUREAU OF RECLAMATION

HAROLD L. ICKES, SECRETARY OF THE INTERIOR

HARRY SLATTERY, UNDER-SECRETARY OF THE INTERIOR (in charge of reclamation)

John C. Page, Commissioner — Roy B. Williams, Assistant Commissioner

J. Kennard Cheadle, Chief Counsel and Assistant to Commissioner; Miss Mae A. Schnurr, Chief, Division of Public Relations; George O. Sanford, General Supervisor of Operation and Maintenance; D. S. Stuver, Asst. Gen. Supr.; Wesley R. Nelson, Chief, Engineering Division; P. I. Taylor, Assistant Chief; A. R. Golzé, Supervising Engineer, C. C. C. Division; W. E. Warne, Director of Information; William F. Kubach, Chief Accountant; Charles N. McCulloch, Chief Clerk; Jesse W. Myer, Chief, Mails and Files Division; Miss Mary E. Gallagher, Secretary to the Commissioner

Denver, Colo., United States Customhouse

R. F. Walter, Chief Eng.; S. O. Harper, Asst. Chief Eng.; J. L. Savage, Chief Designing Eng.; W. H. Nalder, Asst. Chief Designing Eng.; L. N. McClellan, Chief Electrical Eng.; Kenneth B. Keener, Senior Engineer, Dams; H. R. McBirney, Senior Engineer, Canals; E. B. Debler, Hydraulic Eng.; I. E. Houk, Senior Engineer, Technical Studies; Spencer L. Baird, District Counsel; L. R. Smith, Chief Clerk; Vern H. Thompson, Purchasing Agent; C. A. Lyman and Henry W. Johnson, Examiners of Accounts; L. S. Davis, Engineer, C. C. C. Division

Projects under construction or operated in whole or in part by the Bureau of Reclamation

Project	Office	Official in charge		Chief clerk	District counsel	
		Name	Title		Name	Address
All-American Canal [1]	Yuma, Ariz.	Leo J. Foster	Constr. engr.	J. C. Thrailkill	R. J. Coffey	Los Angeles, Calif.
Belle Fourche	Newell, S. Dak.	F. C. Youngblutt	Superintendent	J. P. Siebeneicher	W. J. Burke	Billings, Mont.
Boise	Boise, Idaho	R. J. Newell	Constr. engr.	Robert B. Smith	B. E. Stoutemyer	Portland, Oreg.
Boulder Canyon [1]	Boulder City, Nev.	Irving C. Harris	Director of Power	Gail H. Baird	R. J. Coffey	Los Angeles, Calif.
Buffalo Rapids	Glendive, Mont.	Paul A. Jones	Constr. engr.	Edwin M. Bean	W. J. Burke	Billings, Mont.
Carlsbad	Carlsbad, N. Mex.	L. E. Foster	Superintendent	E. W. Shepard	H. J. S. Devries	El Paso, Tex.
Central Valley	Sacramento, Calif.	W. R. Young	Supervising engr.	E. R. Mills	R. J. Coffey	Los Angeles, Calif.
Shasta Dam	Redding, Calif.	Ralph Lowry	Constr. engr.		R. J. Coffey	Los Angeles, Calif.
Colorado-Big Thompson	Denver, Colo.	Porter J. Preston	Supervising engr.	C. M. Voven	J. R. Alexander	Salt Lake City, Utah.
Colorado River	Austin, Tex.	Ernest A. Moritz	Constr. engr.	William F. Sha	H. J. S. Devries	El Paso, Tex.
Columbia Basin	Coulee Dam, Wash.	F. A. Banks	Constr. engr.	C. B. Funk	B. E. Stoutemyer	Portland, Oreg.
Deschutes	Bend, Oreg.	C. C. Fisher	Constr. engr.	James A. Dolphin	B. E. Stoutemyer	Portland, Oreg.
Gila	Yuma, Ariz.	Leo J. Foster	Constr. engr.	J. C. Thrailkill	R. J. Coffey	Los Angeles, Calif.
Grand Valley	Grand Junction, Colo.	W. J. Chiesman	Superintendent	Emil T. Ficenec	J. R. Alexander	Salt Lake City, Utah
Humboldt	Lovelock, Nev.	Stanley R. Marean	Superintendent	George B. Snow	J. R. Alexander	Salt Lake City, Utah
Kendrick	Casper, Wyo.	H. W. Bashore	Constr. engr.	George W. Lyle	W. J. Burke	Billings, Mont.
Klamath	Klamath Falls, Oreg.	B. E. Hayden	Superintendent	W. I. Tingley	B. E. Stoutemyer	Portland, Oreg.
Milk River	Malta, Mont.	H. H. Johnson	Superintendent	E. E. Chabot	W. J. Burke	Billings, Mont.
Fresno Dam	Havre, Mont.	H. V. Hubbell	Constr. engr.	E. E. Chabot	W. J. Burke	Billings, Mont.
Minidoka	Burley, Idaho	Dana Templin	Superintendent	G. C. Patterson	B. E. Stoutemyer	Portland, Oreg.
Moon Lake	Provo, Utah	E. J. Westerhouse	Constr. engr.	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah
North Platte	Guernsey, Wyo.	C. F. Gleason	Supt. of power	A. T. Stimpfig	W. J. Burke	Billings, Mont.
Orland	Orland, Calif.	D. L. Carmody	Superintendent	W. D. Funk	R. J. Coffey	Los Angeles, Calif.
Owyhee	Boise, Idaho	R. J. Newell	Constr. engr.	Robert B. Smith	B. E. Stoutemyer	Portland, Oreg.
Parker Dam	Parker Dam, Calif.	Howard P. Bunger	Constr. engr.		R. J. Coffey	Los Angeles, Calif.
Pine River	Bayfield, Colo.	Charles A. Burns	Constr. engr.	Frank E. Gawn	J. R. Alexander	Salt Lake City, Utah
Provo River	Provo, Utah	E. O. Larson	Constr. engr.	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
Rio Grande	El Paso, Tex.	L. R. Fiock	Superintendent	H. H. Berryhill	H. J. S. Devries	El Paso, Tex.
Elephant Butte Power Plant	Elephant Butte, N. Mex.	Samuel A. McWilliams	Resident engr.	H. H. Berryhill	H. J. S. Devries	El Paso, Tex.
Riverton	Riverton, Wyo.	H. D. Comstock	Superintendent	C. B. Wentzel	W. J. Burke	Billings, Mont.
Salt River	Phoenix, Ariz.	E. C. Koppen	Constr. engr.	Edgar A. Peek	R. J. Coffey	Los Angeles, Calif.
Sanpete	Provo, Utah	E. O. Larson	Constr. engr.	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah
Shoshone	Powell, Wyo.	L. J. Windle	Superintendent [2]	L. J. Windle [2]	W. J. Burke	Billings, Mont.
Heart Mountain division	Cody, Wyo.	Walter F. Kemp	Constr. engr.	L. J. Windle [2]	W. J. Burke	Billings, Mont.
Sun River, Greenfields division	Fairfield, Mont.	A. W. Walker	Superintendent		W. J. Burke	Billings, Mont.
Truckee River Storage	Reno, Nev.	Charles S. Hale	Constr. engr.	George B. Snow	J. R. Alexander	Salt Lake City, Utah
Tucumcari	Tucumcari, N. Mex.	Harold W. Mutch	Engineer	Charles L. Harris	H. J. S. Devries	El Paso, Tex.
Umatilla (McKay Dam)	Pendleton, Oreg.	C. L. Tice	Reservoir supt.		B. E. Stoutemyer	Portland, Oreg.
Uncompahgre: Repairs to canals	Montrose, Colo.	Denton J. Paul	Engineer	Ewalt P. Anderson	J. R. Alexander	Salt Lake City, Utah.
Upper Snake River Storage [3]	Ashton, Idaho	H. A. Parker	Constr. engr.	Emmanuel V. Hillius	B. E. Stoutemyer	Portland, Oreg.
Vale	Vale, Oreg.	C. C. Ketchum	Superintendent		B. E. Stoutemyer	Portland, Oreg.
Yakima	Yakima, Wash.	J. S. Moore	Superintendent	Philo M. Wheeler	B. E. Stoutemyer	Portland, Oreg.
Roza division	Yakima, Wash.	Charles E. Crownover	Constr. engr.	Alex S. Harker	B. E. Stoutemyer	Portland, Oreg.
Yuma	Yuma, Ariz.	C. B. Elliott	Superintendent	Noble O. Anderson	R. J. Coffey	Los Angeles, Calif.

[1] Boulder Dam and Power Plant. [2] Acting. [3] Island Park and Grassy Lake Dams.

Projects or divisions of projects of Bureau of Reclamation operated by water users

Project	Organization	Office	Operating official		Secretary	
			Name	Title	Name	Address
Baker (Thief Valley division) [1]	Lower Powder River irrigation district	Baker, Oreg.	A. J. Ritter	President	F. A. Phillips	Keating.
Bitter Root [4]	Bitter Root irrigation district	Hamilton, Mont.	N. W. Blindauer	Manager	Elsie H. Wagner	Hamilton.
Boise [1]	Board of Control	Boise, Idaho	Wm. H. Tuller	Project manager	L. P. Jensen	Boise.
Boise [1]	Black Canyon irrigation district	Notus, Idaho	W. H. Jordan	Superintendent	L. M. Watson	Caldwell.
Burnt River	Burnt River irrigation district	Huntington, Oreg.	Edward Sullivan	President	Harold H. Hursh	Huntington.
Frenchtown	Frenchtown irrigation district	Frenchtown, Mont.	Edward Donlan	President	Ralph P. Schaffer	Huson.
Grand Valley, Orchard Mesa [3]	Orchard Mesa irrigation district	Grand Jctn., Colo.	C. W. Tharp	Superintendent	C. J. McCormich	Grand Jctn.
Huntley [4]	Huntley irrigation district	Ballatine, Mont.	E. E. Lewis	Manager	H. S. Elliott	Ballatine.
Hyrum [3]	South Cache W. U. A.	Wellsville, Utah	B. L. Mendenhall	Superintendent	Harry C. Parker	Logan.
Klamath, Langell Valley [1]	Langell Valley irrigation district	Bonanza, Oreg.	Chas. A. Revell	Manager	Chas. A. Revell	Bonanza.
Klamath, Horsefly [1]	Horsefly irrigation district	Bonanza, Oreg.	Henry Schmor, Jr.	President	Dorothy Eyers	Bonanza.
Lower Yellowstone [4]	Board of Control	Sidney, Mont.	Axel Persson	Manager	Axel Persson	Sidney.
Milk River: Chinook division [4]	Alfalfa Valley irrigation district	Chinook, Mont.	A. L. Benton	President	R. H. Clarkson	Chinook.
	Fort Belknap irrigation district	Chinook, Mont.	H. B. Bonefright	President	L. V. Bogy	Chinook.
	Zurich irrigation district	Harlem, Mont.	C. A. Watkins	President	H. M. Montgomery	Chinook.
	Harlem irrigation district	Harlem, Mont.	Thos. M. Everett	President	Geo. H. Tout	Harlem.
	Paradise Valley irrigation district	Zurich, Mont.	R. E. Musgrove	President	J. F. Sharples	Zurich.
Minidoka: Gravity [1]	Minidoka irrigation district	Rupert, Idaho	Frank A. Ballard	Manager	O. W. Paul	Rupert.
Pumping [1]	Burley irrigation district	Burley, Idaho	Hugh L. Crawford	Manager	Frank O. Redfield	Burley.
Gooding [1]	Amer. Falls Reserv. Dist. No. 2	Gooding, Idaho	S. T. Baer	Manager	Ida M. Johnson	Gooding.
Newlands [3]	Truckee-Carson irrigation district	Fallon, Nev.	W. H. Wallace	Manager	H. W. Emery	Fallon.
North Platte: Interstate division [4]	Pathfinder irrigation district	Mitchell, Nebr.	T. W. Parry	Manager	Flora K. Schroeder	Mitchell.
Fort Laramie division [4]	Gering-Fort Laramie irrigation district	Gering, Nebr.	W. O. Fleenor	Superintendent	C. G. Klingman	Gering.
Fort Laramie division [4]	Goshen irrigation district	Torrington, Wyo.	Floyd M. Roush	Superintendent	Mary E. Harrach	Torrington.
Northport division [4]	Northport irrigation district	Northport, Nebr.	Mark Iddings	Manager	Mabel J. Thompson	Bridgeport.
Ogden River	Ogden River, W. U. A.	Ogden, Utah	David A. Scott	Superintendent	Wm. P. Stephens	Ogden, Utah
Okanogan [1]	Okanogan irrigation district	Okanogan, Wash.	Nelson D. Thorp	Manager	Nelson D. Thorp	Okanogan.
Salt Lake Basin (Echo Res.) [3]	Weber River Water Users Assn.	Ogden, Utah	D. D. Harris	Manager	D. D. Harris	Layton.
Salt River [2]	Salt River Valley W. U. A.	Phoenix, Ariz.	H. J. Lawson	Superintendent	F. C. Henshaw	Phoenix.
Shoshone: Garland division [4]	Shoshone irrigation district	Powell, Wyo.	Paul Nelson	Acting irri. supt.	Harry Barrows	Powell.
Frannie division [4]	Deaver irrigation district	Deaver, Wyo.	Floyd Lucas	Manager	R. J. Schwendiman	Deaver.
Strawberry Valley	Strawberry Water Users' Assn.	Payson, Utah	S. W. Grotegut	President	E. G. Breeze	Payson.
Sun River: Fort Shaw division [4]	Fort Shaw irrigation district	Fort Shaw, Mont.	C. L. Bailey	Manager	C. L. Bailey	Fort Shaw.
Greenfields division [4]	Greenfields irrigation district	Fairfield, Mont.	A. W. Walker	Manager	H. P. Wangen	Fairfield.
Umatilla: East division [1]	Hermiston irrigation district	Hermiston, Oreg.	E. D. Martin	Manager	Enos D. Martin	Hermiston.
West division [1]	West Extension irrigation district	Irrigon, Oreg.	A. C. Houghton	Manager	A. C. Houghton	Irrigon.
Uncompahgre [3]	Uncompahgre Valley W. U. A.	Montrose, Colo.	Jesse R. Thompson	Manager	H. D. Galloway	Montrose.
Yakima, Kittitas division [1]	Kittitas reclamation district	Ellensburg, Wash.	V. W. Russell	Manager	G. L. Sterling	Ellensburg

[1] B. E. Stoutemyer, district counsel, Portland, Oreg.
[2] R. J. Coffey, district counsel, Los Angeles, Calif.
[3] J. R. Alexander, district counsel, Salt Lake City, Utah.
[4] W. J. Burke, district counsel, Billings, Mont.

Important investigations in progress

Project	Office	In charge of	Title
Colorado River Basin, sec. 15	Denver, Colo.	E. B. Debler and P. J. Preston	Senior engineers.
Boise-Weiser-Payette	Boise, Idaho	Lester C. Walker	Engineer.
Canton and Fort Supply	Denver, Colo.	A. N. Thompson	Engineer.
Black Hills	Denver, Colo.	Denver Office	
Eastern Slope (Colo.)	Denver, Colo.	A. N. Thompson	Engineer.
Salt Lake Basin	Provo, Utah	E. O. Larson	Construction engineer.
Marias	Shelby, Mont.	Fred H. Nichols	Associate engineer.
Bear River Surveys	Salt Lake City, Utah	E. G. Nielsen	Associate engineer.
King's River-Pine Flat	Fresno, Calif.	S. P. McCasland	Associate Engineer.
Fort Peck Pumping	Glasgow, Mont.	W. G. Sloan	Engineer.
Gallatin Valley	Denver, Colo.	W. G. Sloan	Engineer.
Columbia Basin	Ephrata Wash.	H. A. Parker	Irrigation Engineer

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NIGHT CONSTRUCTION AT BARTLETT DAM, SALT RIVER PROJECT, ARIZONA

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